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SCIENTIFIC AMERICAN

JANUARY 1926

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SCULPTORS IN IRON AND STEEL

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"The Most Significant Forward Step in MOTOR *Design in a Quarter Century."*

Announcing—

a motor bearing that has all the old, familiar sleeve-type advantages, but that is

Sealed

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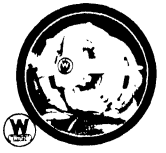
Dirt can't get in—

Removes forever the cause of motor bearing troubles.

This motor has driven a boring mill without any attention for over nine months. Note the dust that covers the bearing housing. It is perfectly dry and can be blown off easily.

The windings in this motor driving a machine tool are bone-dry. No oily film or coating was apparent on the motor windings even after ten months of continuous operation.



This motor is being used in severe machine tool service. When the photograph was taken it had been operating over ten months without oiling. The oil level in the overflow plug had not lowered perceptibly.

This motor replaced one with conventional bearings that had given serious trouble due to burn-outs caused by oil leakage. No oil had been added even after eleven months of operation in this Ohio steel mill.

Westinghouse Motors Have **Sealed Sleeve** *Bearings*

Ask any operating or maintenance man what type of bearing is most satisfactory for general purpose motors and he'll tell you "sleeve-type bearings." They have a low coefficient of friction because the shaft "floats" on a film of oil. This oil film always separates the surfaces of the shaft and the bearing. And since the area of these surfaces is large, the bearing has longer life than is obtainable in other types. The oil film acts as a cushion, too, so that the effect of shocks, vibration, and jars which continually arise in service is reduced.

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Exhaustive operating and service experience has developed other advantages which will interest you, and which prove conclusively that the motor bearings of the future will be **Sealed Sleeve** bearings. **Sealed Sleeve** bearings are available only in Westinghouse motors, and all Westinghouse motors for general use now offer their advantages.

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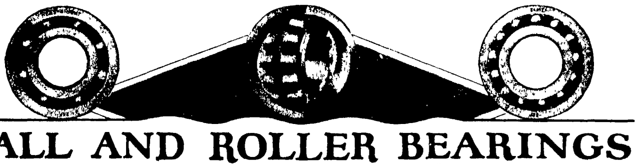

BALL AND ROLLER BEARINGS

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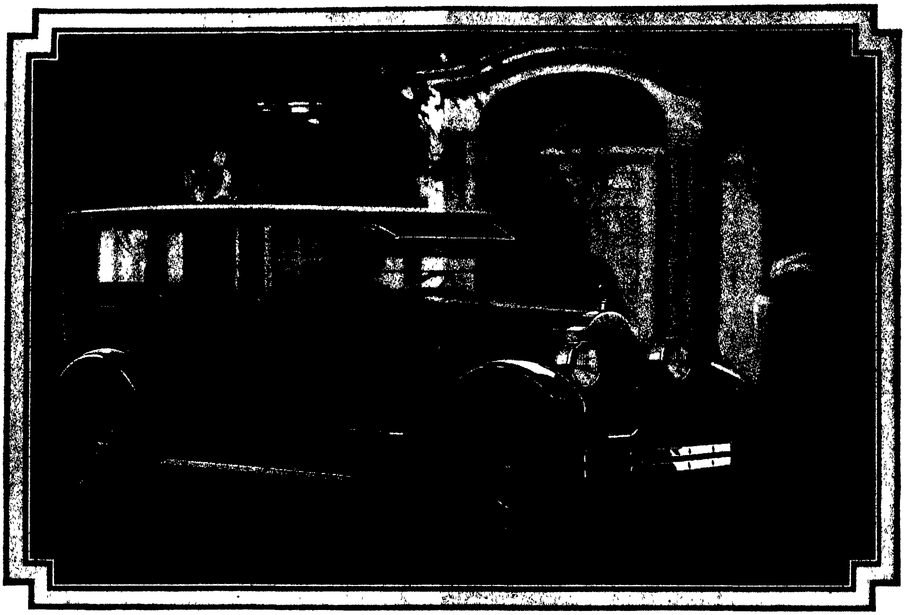

How Often Do You Buy A War Tax?

EACH time you buy a motor car you pay for five things in which you never can take a ride.

These are: war tax—freight charge—factory's profit—dealer's profit—salesman's commission.

Once every five years or more is often enough to afford yourself the luxury of such purchases.

Those who buy the Packard Six expect, on the average, to keep their cars more than five years, spending the minimum in war tax and other outside charges.

Packard encourages its owners in keeping their cars, through retaining the beauty of Packard lines and in announcing no yearly models. It is now more than ten years since Packard offered yearly models.

The most recent evidence of Packard's interest in its owners is the chassis lubricator and motor oil rectifier, found only in Packard cars. Together they double the life of the car.

The Packard Six Five-passenger Sedan is illustrated—$2585 at Detroit. Packard Six and Packard Eight both are furnished in nine body types, four open and five enclosed. Packard distributers and dealers welcome the buyer who prefers to purchase his Packard out of income instead of capital.

PACKARD

ASK THE MAN WHO OWNS ONE

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, JANUARY, 1926 EIGHTY-SECOND YEAR

SHIBBOLETH

IN ancient times the Greeks and Romans consulted their oracles and, whatever the portend of the omen, were guided thereby.

Today, we read of some scientific discovery, perhaps an invention which is heralded as portending vast improvement in one of the necessities of life, or some new means of checking a pernicious disease, or a keystone step in the advance of science. What is the truth of it all? Is it as it is claimed? Is there reason to believe its development will fulfill the promise? It is just this that we aim to give our readers—the facts of today's accomplishment as a portend of the development of tomorrow. So we have adopted the shibboleth, "The magazine of today and tomorrow."

SIGNIFICANT

SOMETIMES money speaks very precisely where words only speak vaguely. Here is an amusing case in point, taken from an editorial in the well-known *Journal of the American Medical Association*, the professional magazine read by the majority of the American physicians. It seems that one of the insurance companies makes a special feature of insuring doctors—and other healers that are not regular doctors—against damage suits for malpractice. Thus it costs an M.D $12 50 a year to insure himself against such suits to the extent of $5,000 But it costs the practitioner who uses the E R.A (Electric Reactions of Abrams) methods $50 to get the same protection.

Now the insurance company is no stickler for sentiment and its rates are based on definite, past experience—nothing else; and certainly not on guess-work. In other words, they know pretty closely how great their "risks" are. Twelve dollars and fifty cents against $50 is four to one.

Money does talk very plainly, sometimes!

NOISE

THE good people who have banded themselves together in the effort to reduce unnecessary and intolerable noises in our cities should be pleased to note that the growth of electric welding may on some future day—and the sooner the better—get rid of the machine-gun rattle of the pneumatic riveter. Those of us who work in cities know what it is to have one's office bombarded by the staccato voice of this machine. The typewriter, whose rattle is sufficiently distracting, is entirely submerged when the steelwork of an office building begins to rise heavenward on an adjoining lot. The hope of the future lies in electric welding.

In This Issue

Are the Continents Drifting?

The continents are made of lighter rocks that float in heavier rocks beneath—this is an established geological principle That these continents also drift to east and west is the hypothesis of an Austrian geologist. At first, other geologists scoffed at this hypothesis—now they discuss it seriously Will they eventually accept it? Page 8

The Indian as a Sociological Problem

Few of us are well informed on the subject of the present political and economic status of the American Indian. Few of us know of the long period of hardship and deprivation that has fallen upon this one-time majestic race. You will be interested in their story on page 5.

Spirit Mediums Fail in Test

Is it possible to communicate with the dead? Through a simple test, conducted by Dr J. Allen Gilbert and with our assistance, it would seem that the answer to that question is in the negative. Page 13

Your Ancestors in Tropical England

A half million years ago in Yorkshire they hunted the sabre-toothed tiger with flint weapons This was before England was an island. Here is a story which Mr. J. Reid Moir reads from flint flakes. Page 20.

Comfort from Your Motor

The reduction of vibration and friction constitute two of the most important advances in motorcar development On page 14, Mr. H W Slauson, automotive authority, tells of the vast improvements in 1926 engine design

MORE THAN 175 PICTURES

Complete table of contents will be found on page 72.

For Next Month

Ho! Would-be Telescope Makers

The precious data that has been unavailable for so many years—how to make reflecting telescopes and their marvelous concave mirrors—will be told with numerous special drawings by R W. Porter, veteran telescope maker

Can We Feed All Our Immigrants?

The more people who come here the more food and the more cattle must be produced to feed them But, as they fill up the country the less land we will have available to raise foodstuffs. Dr. E E. Free discusses this vital question

What Is Life?

To this question, perhaps the greatest of all scientific questions, man must answer, "We are still in the dark" But there are signs of dawn advancing. Dr. D. T. MacDougal, of the Carnegie Institution, has succeeded in duplicating some of the mysterious life processes in an artificial plant cell

Other articles on Mapping Alaska, Treatment of Bronzes; Conservation of Our Soil; Snow Flowers, Radio; Astronomy.

MORE THAN 175 PICTURES

¶ ***Do you believe a two dollar bill is unlucky? Some people think so. If you are one of them try this formula: Put it in an envelope and send it to the Scientific American. For half a year you will think yourself mighty fortunate every month.***

TELESCOPES

EVIDENTLY we have "started something" Everybody wants to be a telescope maker. We are bombarded with letters requesting, supplicating, demanding that we publish instructions for making a telescope of the kind shown in our November issue Every mail brings in more letters.

The first instructions, telling where to get materials and just how to proceed with the work, will reach you in the February issue, out January 20. More will follow in the March issue.

WHICH?

TWO factions of scientists are at odds One faction says civilization started in one place in the world and spread from this center. They place it near Egypt Sun worship, ear-piercing, tattooing, pyramids, irrigation, similarity of art, and a long list of even more peculiar manners and customs argue for a common origin, they claim.

The other faction says "No These similarities of manners and customs and superstitions simply show that the human mind works about the same everywhere Given two or several isolated peoples, as time goes on they will develop similar peculiarities because there is *an inherent tendency in man to develop culture* by the same stages and in the same way." They call this tendency "psychic unity"

The leader of the minority group is Professor G Elliot Smith of the University of London He has written a book called "Elephants and Ethnologists," reviewed in this issue, to prove that the remarkable civilization of the Maya Indians was only a transplantation from the Old World center of culture dispersion

Orthodox science says Professor Smith is mistaken—the Maya culture was originated here, by the Indians themselves independent of the Old World

OMNISCIENCE

IN the history of the world there have been a handful of men credited with holding in their own craniums all the knowledge there was Aristotle was such a one Lord Bacon who "took all knowledge for his province" was another. Dr Johnson was another

And today? We have men of tremendous intellectual power, men who know many things of which their forebears never dreamed But for one man to know everything that all of the rest of us know? Well, there recently was compiled a "World List of Scientific Periodicals." It shows more than *24,000* periodicals publishing the results of scientific research

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THE INDIAN WAR-PATH OF 1925

The Tragedy of the Indian

The Story of Indian Wrongs as Written in the Records of Congress

ONLY the law of change is changeless. Half a century ago no one viewed the Indian problem in its purely scientific aspects. Even now, to the ordinary person it is one of mere sentiment demanding, perhaps, a somewhat more charitable attitude on the part of the nation than in the past, periodic appropriations, and an annual report from a bureau of the Department of the Interior created in 1846 to deal with the aborigines. Now and then the country is regaled with some story in the press about an Indian and an oil well. There have been many stories too about individual Indians in the late war. Some of us—a surprisingly few—have heard that full citizenship was conferred on all the Indians in 1924, and in a vague way it is known that the Indians we now and then see in the wild west shows and the motion pictures represent a past era. From all these things we conclude—also in a vague way—that the Indian problem is no more.

Revision of Indian Policy Necessary

Presto! The situation changes in a twinkling. Certain Indians in widely separated sections—the eighteen California tribes, the Yankton Sioux of South Dakota, the Six Nations of New York—employ as counsel Colonel Jennings C. Wise, to litigate certain remaining rights.

With a traditional interest in the Indians that had been aroused by a recent experience with them in the late war, Colonel Wise examines the cases submitted to him. He sees that in all of them there is a great and common underlying principle. The Indians are no longer merely the political wards of a guardian Government over whom Congress is free, as in the past, to exercise an almost unlimited plenary political power. When they were enfranchised, the nation became a trustee at law of their property. That principle he sees must be established, and so he presents to Congress a plea for the Indian citizens of the United States which is designed to arouse the country to a recognition of the fact that, with the change of status of the Indians from that of mere wards to citizens, a revision of the entire Indian policy of the Government becomes necessary.

The plea is printed and widely distributed. Its author, declares Philip Alexander Bruce, is to be congratulated "in the name of national decency," for he has lifted the Indian question above the plane of sentiment and caused it to take its place before Congress as a sociological and political problem of the first rank.

A Problem That Must Be Solved

Incontestably, the greatest blot upon the Government and people of the United States is their treatment of the Indian. It is a story of brutal tyranny, broken pledges and cynical contempt. Strong words? Yes. But read this article by an authority and you will have to confess that they are true. So far as may be, Congress must atone for the past by swift and adequate legislation for the unhappy descendants of those proud races whom our forefathers dispossessed.

The Indian policy of the nation is, perhaps, the greatest reproach to the American people. Although the Indians, measured by European standards, were the most moral people known to history, the colonial Englishman's church deemed them the "spawn of hell," to be extirpated in the spirit of the Old Testament. Desirous of their lands the frontiersman invented the useful fiction that a people who had occupied definite tribal domains from time immemorial were nomads without attachment to the soil. Thus, when, in 1776, the United States assumed political jurisdiction over these former subjects of the British Crown, the Americans along the frontier deemed the rights of the Indians and the buffalo to be on a parity. Said Brackinridge, a frontier editor, in 1782: "So far from admitting the Indian title, I would as soon admit that of the buffalo." Again: "the animals vulgarly called Indians, being by nature fierce and cruel, I consider their extirpation would be useful to the world while entirely honorable to those who would effect it."

With such a view extant among the so-called civilized whites, it was not unnatural that the Indian should have become fierce in the defense of his lands—and that the idea should have gained credence that "the only good Indian is a dead Indian."

Constitution and Statutes Ignored

In vain Washington, who knew his fellow countrymen and was not deceived by them, sought to prevent the massacre of the Indians and to protect them in their admitted rights. The Constitution itself forbade the acquisition of their lands save by United States treaties. New York ignored the Constitution and the statutes. Georgia, with the tacit consent of John Quincy Adams and Jackson twice nullified the mandates of the Supreme Court, threatening a resort to arms to prevent their enforcement, while the people of Alabama threatened to secede from the Union if Indian statutes were rendered effective. Under Jefferson, Madison and Jackson, dependent as they were for their political support upon the "new democracy" of the frontier, the Buffalo Party had free play.

In 1824 Monroe, hearkening to the wisdom and justice of Washington and Marshall, timidly proposed to give the Indians land individually in order that they might be emancipated from their aboriginal state and be enabled to compete in the economic order of civilization The nation would not have it. He then proposed their concentration in the Indian Territory This was partly effected under Jackson as the means of driving them, despite the Supreme Court, from the white man's path Even there they were molested and abused

Then came a veritable reign of terror for the Indians of the west. Along the Oregon Trail and in the gold fields of California and the Black Hills they were destroyed like the buffalo. The Californians and Oregonians demanded that they be removed. Congress passed acts providing for the negotiation of treaties with the Indian tribes of the Pacific coast in which reservations were promised them for the lands surrendered. Pending the ratification of these treaties they were induced to remove. Political influence prevented the ratification by the Senate of the treaties. Thus deceived, dispossessed, betrayed, a quarter of a million helpless people, who had been partly civilized and Christianized by the Spaniards, whose rights were secure under the laws of Spain and Mexico, and whose rights had been solemnly guaranteed by the United States in the treaty of Guadalupe Hidalgo, were harried from place to place, massacred at will, and left to become vagrants upon the earth. Today, they are homeless and dependent upon charity.

Grant Tried to Institute Reforms

In addition to the gold-seekers another enemy was soon to appear. In 1850 Congress adopted the policy of granting western lands to corporate interests in order to promote the construction of the transcontinental railroads. To this end, grants aggregating 155,000,000 acres of land with slight regard to Indian rights were made. Then came the Homestead Act of 1862 which caused the remaining Indian lands to be deluged with white settlers. The Indians of the east and the Pacific coast having been entirely dispossessed, now came the turn of the plains Indians. In all, it was necessary for the guardian Government to wage over fifty official wars against its wards during the first century of its existence in the civilizing process which it brought to bear, although there is not one instance in which the Indians sought to defend themselves until after protection had been denied them. During this same period the Indians north of the Canadian border, protected by their Government, remained in peace.

It was a harsh tutelage which the Indians of the United States underwent It was not until Grant became president that the responsibility of the nation was recognized At his instance the Indian Homestead Act of 1875 was passed and steps taken culminating in the General Allotment Act of 1887—measures designed to absorb the Indians in the economic and social order of the political society of the nation. That absorption was to be expedited by education and allotment of land in severalty to the Indians. Those who took allotments were to become citizens. Inadequate provisions for Indian education having been made, allotment has naturally proceeded slowly. Yet, in 1917, the Indians were called upon to fight for the nation. Responding with a spirit not equalled by that of the white or black citizens, and without regard to citizenship, they furnished 17,000 soldiers. Among all the Indians less than 250 sought exemption. As a reward they were enfranchised in 1924; but today, half a century after Grant instituted his wise reforms, over 150,000 tribal Indians remain enslaved to the outworn economic and social systems of an aboriginal race. Far more has been done for the Negroes in sixty years, for the Filipinos and Hawaiians in thirty years, than has been done for the Indians in a century and a half. Although the political massacre of the California Indians is, perhaps, the most scandalous incident in the history of the United States, not an official hand has been raised to help them, while the efforts of the Indian Board of Coöperation of California—a private philanthropic association—have so far proved abortive.

Courtesy of Glacier National Park

TEEPEES OF BLACKFEET INDIANS

Soon this picturesque type of home will no longer exist

Appeals to the Government Unheeded

It would be useless to attempt here an accounting as between the United States and its Indian wards for the purpose of determining whether or not the compensation paid for their lands has been "ample." Suffice it to say that if the acreage acquired by the United States, or the political guardian, from the Indians, or its wards, were placed in one column, and the price actually paid therefor in another, it would require a stretch of the imagination to construe the purchase price as "ample," or one that the Indians had in fact voluntarily accepted. History shows that the actual course of the Government of the United States in dealing with this dependent people has ordinarily embodied the following steps: 1. Disputes over Indian lands between the Indians and white settlers; 2. local violence to the Indians by white intruders; 3. appeals to the Government by the Indians for the protection of their rights; 4 failure of the Government to provide, or the provision of inadequate protection; 5. efforts on the part of the Indians toward self-protection, and sometimes retaliation for wrongs done them; 6. official military restraint and often chastisement; 7. so-called treaties of cession at a price fixed by the guardian Government, sometimes procured fraudulently by shrewd negotiators and undue influence upon tribal representatives, sometimes compelled by threat of force, seldom voluntary.

Such, in brief, is the cold outline of the national history with respect to this dependent people. Deny it though we may, the facts are written in large letters in the debates of Congress and the records of the fifty-odd wars the nation has waged against this helpless race.

The past is gone forever. It is the present situation of the Indians that requires to be corrected. The facts of sociological importance are that in 1492—when the White Man assumed responsibility for the Red Race—there were, according to the ethnological experts, 918,000 aborigines within the pres-

Courtesy of the Museum of the American Indian—Heye Foundation

ZUÑI WOMEN AT WORK

LEFT *Taking corn from the cob* CENTER, ABOVE *Kneading bread and making it ready for the baking.* RIGHT: *Preparing clay for the making of pottery*

E. M. Newman

HOW THE WOMEN OF ACOMA CARRY BURDENS

The Indian village of Acoma is situated on top of a high mesa in western New Mexico The three-story houses are terraced back from the streets

Courtesy of the Museum of the American Indian—Heye Foundation

HOW THE BIG CHIEF PAINTS HIMSELF

The primitive Piutes of the plateau country still paint their bodies It is doubtful, however, that the papoose, when he grows to manhood, will follow his father's practice

ent continental limits of the United States. In 1910 there were 403,000 so-called Indians of all degrees of admixture—a decrease of nearly sixty percent in four centuries. We know the cause of this decrease—wars, wholesale murder, small-pox, tuberculosis, sexual diseases, whiskey, attendant dissipation, lowered vitality, starvation. Removals account for a very small part of it. In 1920, however, but a decade later, the census showed that there were but 265,683 persons in the United States who claimed to be Indians, while the Commissioner of Indian Affairs in 1924 reported but 320,497 legal Indians of all degrees of admixture, and 162,602 full bloods Query? What became of the 137,317 Indians who vanished between 1910 and 1920? How is the discrepancy between the census figure for 1920 and the number of legal Indians in 1924—a difference of 54,814—accounted for?

Plainly, the Indians are amalgamating at a very rapid rate with the whites. The returns mentioned are conclusive that a sixth of all the Indians of whatever degree of red blood, or persons who claim to be Indians for purely legal reasons, are indiscernible as such, and must claim to be Indians to be distinguished from the whites

Reservations Have Become Prisons

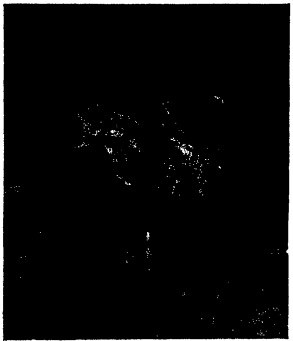
By reason of the lowered vitality of the Red Race in consequence of its experience of the past four centuries, the average Indian seems to be physically inferior to the average white man Yet, the average half breed does not appear to be physically inferior to the average Indian, his mental capacity is inferior to that of neither race; his intellectual growth depends upon environment and opportunity.

There can be little doubt that morally the red man is the equal of the white. In the late war the psychiatric test was applied to thousands of all four races—white, red, yellow and black. The red man, unlike the Asiatics and Africans, showed a greater power to resist mental strain than whites. An eminent authority, who knows the red race, insists that this superiority is due to the spiritual poise that has come to it from a philosophy of life that makes God not an anthropomorphic deity but a universal, omnipresent, benignant force in nature, giving to the Indian an ability to stand fast, an integrity, a fundamental something which lies at the roots of his race, a something in human character to which faith may be pinned, as well as his characteristic staunchness, dignity, self-respect, and strength of mind.

The foregoing conclusion affords the clue to the solution of the sociological problem of the Indians. To insure the economic is but to insure the social welfare of a people. If the remaining pure Indian blood is an inevitable national admixture, common sense dictates that it be protected in order that it be not debased and that with it an inferior strain be not admitted Without regard to justice and the due of the Indians, therefore, it goes without saying that for the good of the white man no Indian should be denied the highest form of free education of which he is capable, and that rudimentary education, at least, should be enforced upon all Indians. Medical aid, hospitals, and asylums for orphans, the blind, aged, infirm, homeless and insane, should be freely placed at their disposal and no want on their part suffered to exist in these respects.

We now come to the purely political problem that confronts Congress

The Indian social unit is the tribe. Half a century ago the remnants of the tribes were confined to reservations as the only possible expedient to save them. Under the existing circumstances the reservation policy was sound, since reservations were no more nor less than refuges. Viewed in any other light the system would have been unjustifiable. Nor was it ever assumed by President Grant that reservations were to be more than the medium of transforming the remaining hard-pressed Indians from their aboriginal state to the economic order of the nation In order to transform an aborigine it was essential, therefore, that he be given an estate adequate to enable him to abandon the communal society of the tribe To this end the Indian Homestead Act of 1875 and the General Allotment Act of 1887 were passed. Under both, he could, by his own act, acquire an estate of which the Government stood as trustee in behalf of himself and his posterity, protecting him against his own limitations and the wiles of the unscrupulous whites. Today approximately half the Indians retain their tribal relations, still speaking the language of their great-great-grandfathers. Herded like the few remaining buffalo on reservations which now merely serve to incarcerate them in the aboriginal economic and social order, from refuges the reservations have become for them dark prisons from which the sunlight of civilization is excluded by the outworn governmental system.



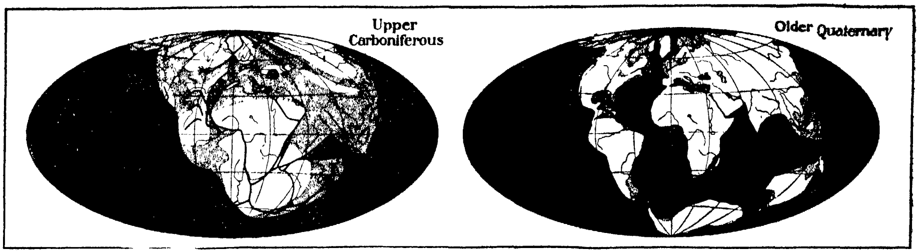
E. M. Newman

ACOMA INDIAN MAIDENS

The peculiar hair dress indicates that they are unmarried Upon marriage, the hair is worn in a long swirl

Their Needs Must Be Studied

Plainly the old political system must be revised. How should this be done? Not by the passage of new and disconnected statutes The problem must be solved in an intelligent and scientific way First, the needs of the Indians, which vary greatly with localities, must be studied. This can only be done, as pointed out by President Cleveland, by a body of able, unprejudiced men, similar to the Dawes Commission of 1893 On the Commission should be placed only men of vision and ability—trained sociologists, economists, and political scientists. It should include several Indians in order to afford to its white members a lens of understanding, through which the true nature and aspirations of the Indian may be viewed in a sympathetic way Upon the findings and recommendations of such a jury alone can Congress devise the necessary laws to put into effect a policy designed to solve the Indian problem. Until the information that such a commission can acquire is forthcoming, let the well-wishers of the Indians direct their efforts solely to the support of its work and cease to urge upon Congress special legislation that alone can not accomplish the emancipation of the race. For that an entire new and well coordinated political system is necessary.



All Illustrations from "The Origin of Continents and Oceans"

THE ORIGINAL SUPER CONTINENT, 70,000,000 YEARS AGO, AND A LATER PHASE OF CONTINENTAL DRIFT, 500,000 YEARS AGO

Although the present continental outlines are roughly indicated on the left-hand map, these lines did not actually exist on the original super-continent. The map on the right shows the comparatively narrow Atlantic Ocean of the early part of the glacial period. India, once twice as long as now, was "telescoped" into Asia, forming the Himalayas

Are the Continents Drifting?

A New Theory Which Is Arousing Controversy Among Scientists

By Albert G. Ingalls

SUPPOSE a giant, standing in the Pacific Ocean, should place one hand against North America and the other hand against South America, and push both continents eastward across the Atlantic Ocean until they came up against Europe and Africa. If you will look at a map of the world, such as the one shown below, or better still, a globe, you will find that the two Americas would fit the irregular curve of the opposite shores of the Atlantic almost as neatly as a ferryboat fits its slip. They would fit almost like the parts of a jig-saw puzzle.

This seems to be a remarkable coincidence.

Is it only a coincidence?

Professor Alfred Wegener, of the department of mineralogy and climatology at the Austrian University of Graz, says it is not. Millions of years ago, he says, the two Americas, as well as Europe, Asia, Australia, Antarctica and all the islands of the present-day world were one continent, centered around Africa.

Tidal forces—the attraction of the sun and moon for the earth's solid mass (not ocean tides) broke this super-continent up, and the pieces slowly dispersed in various directions, like the blocks of a great, flat cake of floating ice which is broken up by the waves. Some of these pieces, the present continents and islands, are drifting yet, gradually moving away from the nuclear Africa.

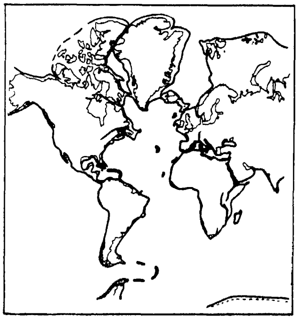
A Theory Under Heavy Fire

This theory is startling. To many it seems absurd. It may prove to be erroneous. It may gain final acceptance among geologists. At the present time it is strongly heterodox, but there is something about it that seems to captivate the interest of scientists. They have given it a fair hearing and it is being discussed seriously in various scientific journals. But it will remain under judgment for at least ten years. About 1935 there will be a way to put it to a strict test. I shall come to that later. In the meantime the reader should not be too quick to condemn the Wegener theory, for, like many other theories that have gradually overcome adverse resistance, there is more to it than one might think at the start.

How could the continents actually drift? Are they not attached to the solid heart of the earth? In fact, are they not an integral part of it? To explain this we shall have to go back a way.

For a long time the geologists, geodesists and geophysicists have known that the earth is solid all through, not molten according to the early belief. Earthquake waves arriving through the earth show us this fact.

The central core of the earth is probably a mixture of nickel and iron. Suess, a famous geophysicist, therefore named this core material *nife* (Ni, nickel, Fe, iron—chemical symbols).



LIKE A JIG SAW PUZZLE

The heavy, black lines represent the real edges of the continents, the shallow continental shelves being a part of them

Surrounding this spherical core of *nife* is a deep layer of material which Suess called *sima*, its chief constituents being silica (Si) and magnesium (Ma). The heavy rock, basalt, is a kind of *sima*.

Third and uppermost comes the lighter *sial*, forming the continents and islands, but lacking in the sea-beds, where the *sima* layer lies bare.

The core of *nife* we can forget in this consideration. The *sima* and *sial* we shall need to remember.

The *sima* layer is heavier than the *sial* of which the continents and islands are composed. Therefore the *sial* lies on top. Basalt has a specific gravity of about 3—that is, it is three times as heavy as water, volume for volume. Granitic and gneissic rocks, which compose most of the land surfaces, have a specific gravity of only about 2.9. The floating blocks of *sial* average about sixty miles thick.

It is hard to think of solid rocks as "floating" on other solid rocks. Rock, however, is viscous, solid as it appears. True, it is not as viscous as things we ordinarily call viscous—motor oil, syrup, tar—but in a relative sense it is viscous.

In laboratory experiments, rocks placed under enormous pressure have been made to flow within fairly short lengths of time. Given more time, less pressure will likewise produce a flow. Even under slight stress some rocks bend. We have all seen thin stone slabs that have sagged at the center.

Another analogy, familiar to geologists, is that between the rocks of the earth's crust and common pitch. You can press your whole weight against cold pitch without deforming it. Yet if you place a fifty-cent piece on its surface and leave it there a while, you will discover that the coin has gradually worked its way down into the pitch. Like pitch, rock will flow if there is time, except that it needs much more time for the same amount of pressure.

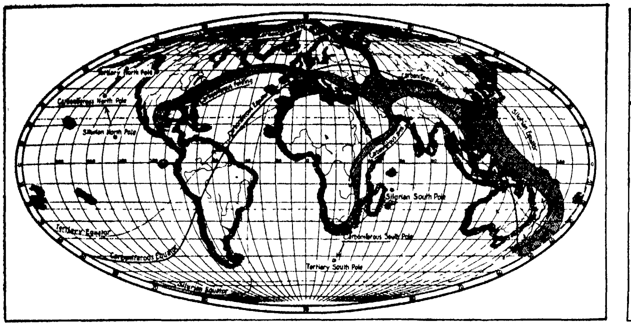
The Continents Are Afloat

If you conceive the continents as blocks of *sial*, some sixty miles thick, based on a heavier layer of *sima* beneath, and if you know that rocks actually do flow under pressure in long periods of time, you will have no difficulty in imagining how the present continents of the earth might have drifted in different directions like the broken cakes of an ice-floe.

The continents must not, however, be conceived as resting on top of the underlying *sima*, but as floating *in* it like a piece of toast in a rarebit. That is, the continents are nearly as dense as the *sima*, therefore they float low, with only about three miles of vertical projection above the ocean bed.

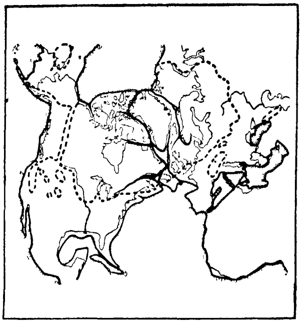
Another point over which we may hesitate is the continental shelf. Where *is* the actual edge of the continent? In school we drew maps (some of us traced them) and thus we learned the geographical outlines of the continents. Now we must forget these mere geographical outlines and learn the revised physiographical map showing the continental shelf as an integral part of the continents. In some places we shall find that there is very little difference. In others there is a great difference in the physiographical outlines. Note Wegener's map.

Florida, for example, extends many miles to the southeast. So does South America. Europe acquires



HOW THE POLES AND THE EQUATOR MAY HAVE SHIFTED

Fossils prove that there have been glacial periods in the tropics, and tropical climates in our arctic regions To account for this, Wegener assumes a shifting of the poles Thus the world's coal deposits could have accumulated near the tropics



WAS THERE ONLY ONE GLACIAL CAP?

When both continents are brought together, the outermost terminal moraines of the ice cap (dotted line) join up evenly

a large wing extending northwest, and the British Isles are merely a little patch on that extension. Most of the area of sea between the East Indies is an integral part of Asia, but the equally shallow area surrounding New Guinea is a part of Australia.

All of these extensions are really slightly submerged plateaus, less than 600 feet beneath the surface of the seas. They are a part of the continental shelf and are therefore a definite part of the continents. All this is common physical geography, and so we must not accuse Wegener of fixing up the continental outlines to make them fit his theory.

Now let us go back in geologic time to the juvenile earth and try to get some idea of the sequence through which its continents are supposed by Professor Wegener to have passed.

For hundreds of millions of years there was only one continent, or super-continent. Life existed on it and evolved practically as our geologies teach, except that instead of existing on separate continents it was all on one greater continent

Thus, early in the Jurassic Period, perhaps 40,000,000 years ago, Antarctica, Australia with New Zealand and New Guinea, India, and South America lay adjoining South Africa, Asia and North America were further away from the center, but were still a part of the single mass.

In the course of the Mesozoic Era (Age of Reptiles) and the Tertiary Period (Age of Mammals) this great area broke up, progressively, into smaller blocks of land, and these began a dispersive drift.

What broke them up? What dispersed them? Here Wegener's theory, which he prefers to call "the theory of the displacement of the continents," is a little shaky. Other scientists have belabored it strenuously because no cause that seemed sufficient to account for the break-up and drift has been given. Dr. Harold Jeffreys, brilliant Cambridge University geophysicist and author of a noted book entitled "The Earth. Its Origin, History and Physical Constitution," refuses to accept the Wegener theory "unless forces enormously greater than any yet suggested are yet available."

Sometimes, however, science makes progress by building up a structure which is out of logical sequence. Thus, "if adequate geological proof of continental drift is forthcoming," says Dr G W. Tyrrell of Wegener's theory, "geologists will believe it despite any assertion of its physical or mathematical impossibility." A cause for the hypothetical drift may be found later

A Way to Test This Theory

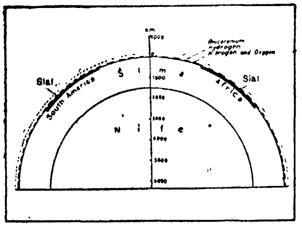
In Cretaceous times, South America broke away from the super-continent and drifted westward until it met with the strong resistance of the well-cooled Pacific Ocean floor. The drifting force continuing, the western margin of South America was crumpled up, and we have the Andes range of mountains.

North America remained attached to Greenland, and Greenland to the Old World, at least by its northern half, until comparatively recently, perhaps only a million years ago Now that it has cast off, Greenland is thought to be moving away from Scotland at the rate of 60 to 120 feet per year. It ought, then, to be easy to test this Greenland drift. In 1823, in 1870 and in 1907 some determinations of longitude were made in Greenland, but this was accomplished by the lunar method which is not absolutely precise Can these figures be trusted? In any case, they will not be trusted

What is planned includes not only Greenland, but many other points in the world. Last year, at a meeting of the world's geodesists, it was voted to establish a world network of longitude determinations obtained by radio time signals, a method which is precise. Ten years hence, a redetermination will tell whether the continents are drifting or not. Radio alone makes this fine degree of precision possible.

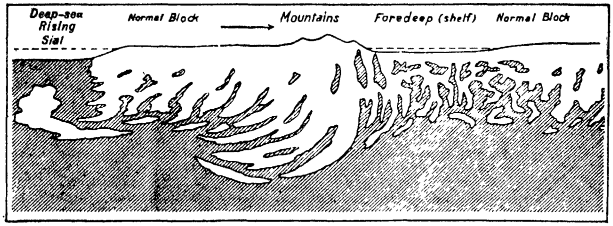
The Wegener theory includes too many details to cover in this space There are interesting check tests which show how several hypothetical former land bridges between some of the continents, which geologists have always had to postulate in order to account for a close similarity between widely separated fossil fauna and floras, are done away with when the continents are considered to have been in actual contact during most of the evolution of plants and animals There are analogies between the rocks of Brazil and Africa There are explanations of the hitherto inexplicable distribution of the evidences of geologically ancient glacial periods. These are explained in convincing, even if rather one-sided, detail in Wegener's recent book, "The Origins of Continents and Oceans" (Dutton), a book of about 200 pages, well suited to the general reader.

Wegener's theory of continental displacement is frankly an hypothesis It is more than a "guess," because it is fairly well controlled by partly established principles of geophysics, a science about which we know, however, comparatively little at the present time.



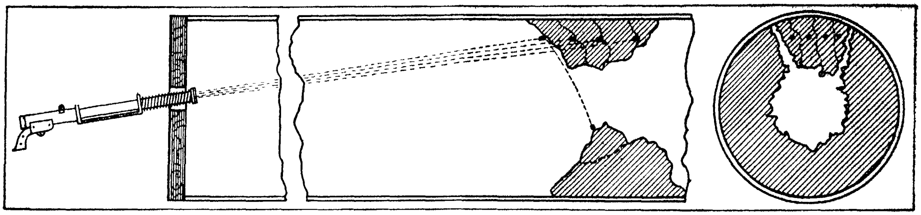
THE CONTINENTS ARE RELATIVELY THIN

This cross-section of the earth is diagrammatic; actually no such uniform conditions are believed to exist



HOW THE *SIAL* OF THE CONTINENTS MAY ACTUALLY JOIN THE *SIMA* BENEATH

The transition is gradual and non-uniform Note that mountains indicate added thickness of sial, required to buoy them up; while shallow underwater areas require less thickness for support This is according to the principle of isostasy



LONGITUDINAL AND CROSS SECTIONS OF THE KILN

The left view indicates the obstruction to be removed and the method of placing the shots The right view shows the method of cutting a keyway out of the obstruction

Shooting Clinker Rings from Kilns

By Captain Edward C. Crossman

AT FIRST glance this may seem like a story better adapted to a sportsman's magazine than one of technical persuasion. Experienced persons tell me, however, that the variety of shooting touched upon in this article has not the least connection with sport.

It appears that the gentlemen engaged in the pleasant and easy business of producing cement from lime rock and other things are troubled with the constant formation of clinker rings in the kilns which affect the flow of the clinker when they are allowed to build up to any extent

Removing one of these rings, without giving the kiln plenty of time to shed its calories, has been impossible, and letting a kiln cool down sufficiently to work on the inside, produced much grief in the cement business because of the time lost in the cooling off and heating up process. Various experiments in removing the rings without cooling the kiln proved failures

Square-nosed Bullets Used

One company, the Dewey Portland Cement Company, of Dewey, Oklahoma, reported that it had to shut down each kiln once or twice a day to bar out the clinker rings, with a dozen men on a water bar and requiring a half hour's time In turn, this required firing the kiln a half hour without feed to restore the proper temperature, while the constant cooling and heating did an unknown amount of damage to the brick

These kilns are pleasing tubular contrivances, roughly ten feet or so in diameter, with fire-brick lining and an internal heat several degrees higher than the reputed temperature of the brazen hinges of Hades In them the two principal components of cement are burned to a clinker, which is later ground to the fine cement familiar to commerce

The rings are glowing masses of practically molten rock, not unlike lava. Once formed they do not easily yield to persuasion

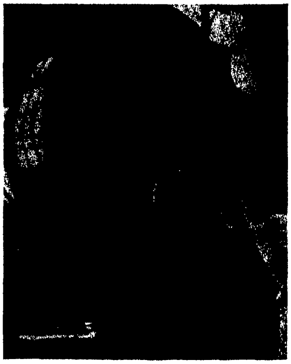
Inasmuch as removal of the ring meant operating from the outside of the fiery kiln and applying force to break through at some point and thus weaken it, some genius evolved the idea of using a gun and shooting away a portion by dint of repeated blows from heavy projectiles.

So they tried the gun method, the program ranging from shotguns with solid balls, to machine guns The method was found to have some promise, but the guns would not stand up to the work

Much publicity was released by one arms company alleging that its make of repeating shotgun was used for this purpose but the process was much more successful on a typewriter than on a clinker ring. Another company made up hollow, brass bombs filled with black powder, the bombs exploding the instant they came in contact with the incandescent ring The scheme was not a success.

The single balls fired from the twelve-gauge repeating shotgun lacked the requisite wallop to smash away the portion of the ring at which the missiles were fired, while the gun would not last more than a thousand shots under the pleasant conditions prevailing at the kiln mouth—intense heat, grit and continuous firing.

The next step was to try an eight-gauge double gun, loaded with a three-ounce cylindrical slug of lead. This is roughly three times the weight of the ordinary round ball used in the twelve-gauge gun.



THE CEMENT KILN GUN IN OPERATION

The gun is mounted on a pivoted bracket at the end of the kiln, and is operated through a peephole

This proved to be much more successful. The projectile had the requisite punch. The only thing lacking was a simple, strong, fool-proof gun that could easily be mounted for the purpose, would inflict no recoil on the operator and would stand the strenuous conditions of the cement business. The operator of the experimental eight-bore double gun which was tried in one of the eastern plants, fired more than 200 shots in one morning through the small peephole leading into the red-hot kiln.

Three strong osteopaths finally brought his shoulder back into approximately its normal position but the experience proved that the shoulder method was entirely out of the question.

The solution of the problem, as worked out by the company conducting the experiments, the Remington Arms Company of New York, was first, using a special cartridge not chambering in any gun other than their special cement gun, somewhat similar to the eight-bore shell, but firing a heavy cylinder of lead of about three ounces The cylinder is cut off square to give full force of impact without penetration. Next, to fire this cartridge, this company developed a simple and strong form of bolt-action, single-shot weapon, using the simple, strong, and crude door-bolt type of breech closure.

This entails no more expertness on the part of an operator than turning up a bolt handle and pulling it back as far as it will go for the insertion of the loaded cartridge, then closing it and pulling the trigger.

The Punch of an Elephant Gun

The gun has a very short barrel, a pistol grip for the firing hand and is mounted with a heavy, spiral spring at the muzzle end to absorb the recoil. The gun is mounted on a pivoted bracket at the end of the kiln with the muzzle opposite a small peephole cut in the kiln wall, permitting the operator to watch the placement of his shots on the selected portion of the clinker ring.

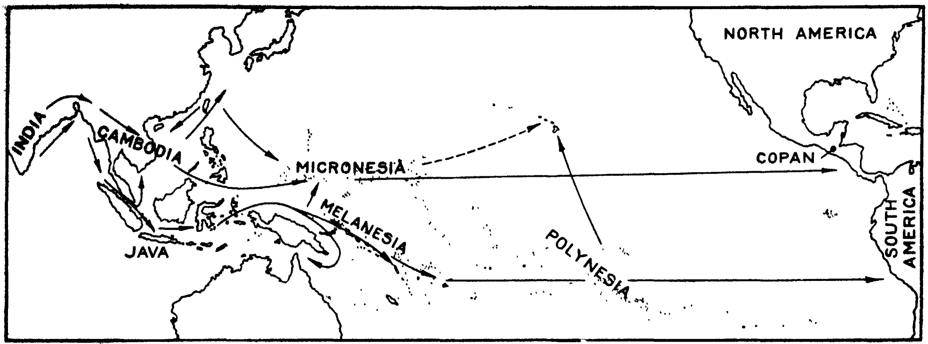
The cartridge is powerful enough to deliver a punch akin to that of an elephant gun, or tank gun. The three-ounce slug, if given a velocity of 800 feet per second, would develop an energy of better than 1,800 foot pounds and little of this would be used up in mere penetration because of the pleasing square face and huge cross section of the slug, which is eight-tenths of an inch in diameter.

The method of using the gun in breaking down the rings is to concentrate the fire on one portion of the ring, placing the bullets close together and in a row, and breaking out a keyway through the ring.

The Dewey Company, before quoted, reports that it finds it necessary to shoot the ring out as soon as it forms, an average of twenty shots being used in the process. The kilns are "down" for this purpose twice a day of twenty-four hours.

As the range is short and the mark large, no expert marksmanship is required. It is reported that almost any man who is able to hit a five-foot doorway with the front end of a wheelbarrow, can be used for this ring shooting.

At the present writing it is reported that six of these guns are in use by six different plants and that they are giving satisfactory results.



Redrawn from Elephants and Ethnologists

HOW SOME SCIENTISTS BELIEVE THE OLD WORLD CULTURE REACHED THE NEW WORLD

According to the theory of Professor G. Elliot Smith, the remarkable culture of the Mayas and ancient Peruvians came from India and Cambodia, with Chinese influence, by two routes, the northern route being the main one. This diffusion of culture across the Pacific in large canoes began at least one thousand years before Christ and continued for centuries

Are These Elephants?

By Albert G. Ingalls

DO THE Copan sculptures made by the ancient Maya race of Honduras, which are reproduced on this page, represent in your opinion, elephants, or would you take them to be intended for tapirs, macaws, turtles or cuttlefish?

Simple as the solution of this question appears to be—for nearly everyone to whom we have shown these figures has pronounced them elephants—two factions of scientists have been engaged for years in a bitter war over it. That war has just broken out anew. Professor G. Elliot Smith, the brilliant and dynamic leader of the so-called "historical" faction which believes that the sculptures are intended for elephants, has written a book in support of his view (*Elephants and Ethnologists*. E. P. Dutton & Co., New York).

Science would not give much thought to the mere interpretation of these four Mayan sculptures were it not for the fact that a decidedly important problem of human history depends on this interpretation. If these figures depict elephants, it practically proves that the remarkable civilization of the Mayas did not originate in the New World without outside assistance, for scientists believe that there were no elephants in America at the time of the Mayas. It would point strongly, therefore, to the theory that other races of people gradually extended their adventures and explorations across the broad Pacific and finally landed, by accident, by design, or by a combination of these two causes, on the western coast of America where they took root, thus transplanting the Old World culture to the New World. This is the view of Professor Smith.

What we now call "civilization" can be traced back to historical beginnings in the countries surrounding or close to the Mediterranean Sea.

Professor Smith's idea takes the origin of all these cultures, Mediterranean, Chinese and American alike, back to a much earlier time in pre-history, when they probably arose on a fundamental basis of a sort of pre-civilization which spread over most of the world.

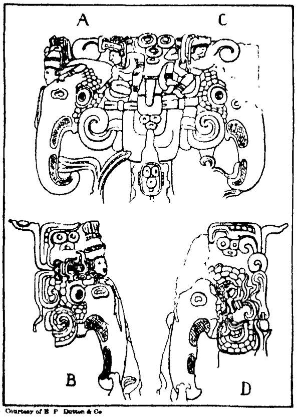
This supposed more ancient world-spreading culture, Professor Smith has named the "heliolithic" culture, a name derived from the words for "sun" and "stone," and so named from the customs of worshipping the sun and of setting up great monuments of single stones, like those of Stonehenge, in England. Survivals of this culture include, among other things, the custom of worshipping the sun, already mentioned; the use of the mysterious swastika symbol, signifying good luck, the "couvade"—the very curious custom of putting the father to bed when a child is born; the single-stone monuments and the building of pyramids, the custom of circumcision; the piercing of the ears; tattooing, the binding of the heads of infants, so that the skull is deformed; exogamy, human sacrifice; and the invention of agriculture by irrigation.

These things are partly commonplace and of such a nature that it is not unreasonable to think that isolated peoples might have hit on them independently in the course of centuries. No one of them, taken alone, would be convincing proof of common origin. But taken as a whole, it is difficult to avoid the belief that these customs do indicate a common source.

We may easily trace these elements of the heliolithic culture both east and west from Egypt or Southern Asia. To the west, they lead us across northern Africa, through Spain and France to western Ireland. To the east they appear to have spread to Mesopotamia, India, and the peninsula of Siam. Beyond this point the culture seems to have taken two eastward paths. The southernmost led through Melanesia, Polynesia and finally reached the west coast of South America where it took root in Peru. The northern branch seems to have reached Central America by way of Micronesia, or the islands of the Pacific, east of the Philippines. How? In large canoes. To quote Professor Smith: "The ancient mariners who made their way into Polynesia discovered and settled in almost every islet on that vast expanse of ocean. Is it at all likely that seamen who wandered as far as Easter Island, Hawaii, and New Zealand, refrained from going further east? Is it not certain that for every boat which chanced to reach Easter Island—a microscopic speck in far eastern Polynesia—there must have been hundreds, if not thousands, that missed it and passed on to the American coast?"

This is where the Mayan sculptures fit into the argument. In India and Cambodia the elephant had religious significance—in fact, it still has. No elephants, mammoths or mastodons lived in Mayan days in America. Is it not natural that the sculptor of the Copan monuments, descended from some earlier sea wanderer and never having seen an elephant himself, but having with him some crude, handed down representation of the elephant, should have mistaken its eye for the nostril and its ear for the eye?

Among those anthropologists who decline to follow Professor Smith there is little tendency to deny that the same cultural elements are common to both the Old World and the New World. What they refuse to do is to conclude that this is more than a coincidence.



Courtesy of E. P. Dutton & Co.

ELEPHANTS? OR MACAWS?

Macaws, say the opponents of Professor Smith, who retorts that to prove it they single out profile D, the most seriously damaged of the four (A, C is the reverse side of B, D)

Our Point of View

A Call for the Automatic Train Stop

THE recent fatal accident on the main lines of the Pennsylvania Railroad between Philadelphia and New York, *when an express train, running in a* thick fog, crashed into the rear of another express train, causing the death of ten people and the injury of thirty or forty others, inevitably suggests the thought that had the automatic train-stop been installed on that section of the line, the collision would not have occurred The Interstate Commerce Commission had ordered forty of the principal railroads of the country to install the automatic stop where the traffic is heavy and peculiarly exposed to the risk of collision, and in justice to the Pennsylvania Railroad Company, it should be remembered that, in common with other railroads, they have been engaged, since the date of that order, in testing out various systems of automatic train control with a view to finding one that will be thoroughly reliable and above all, weather-proof To make a complete installation of automatic control over the thousands of miles covered by the Commission's order will involve an immense expenditure of funds; and the railroads should be allowed a reasonable time to make their preliminary examination very thorough, so that they may feel certain that the type adopted will give satisfactory service

Apparently, the collision was due to a failure of the human element. The engineer of the second train, in spite of the fact that he had a record of twenty-five years of service without an accident, ran by the distant or caution signal, which he claims was hidden in the fog, and apparently saw the red light *only when he was close upon it. The train* ahead had stopped at this red light and started again when it showed clear, and was running at a speed of about ten miles an hour, when the train behind, at a speed of from fifty to sixty miles an hour, crashed into the rear steel sleeper The impact was such that this car was telescoped into the one ahead.

The annual number of collisions on our railroads is diminishing steadily, but as long as their prevention depends upon the fallible human element, they are liable to occur. Only when automatic train control is installed will absolute safety be assured This, as we have said, will be a costly work, and the demand for it comes, unfortunately, at a time when the railroads are struggling by rigid economies to produce that minimum dividend of six percent, which *is essential if they are to secure the necessary* capital for upkeep and betterments.

Mitchell *versus* Discipline

DUE to the widespread misunderstanding, we think it should be made clear that Colonel Mitchell is being tried, not for his views on aviation, but for his breach of military regulations and the means and manner of his expressing these views. It is a violation of military regulations for an officer to air his opinions on military matters by conducting propaganda through the press, and it is doubly a breach of military regulations for an officer, in a public statement, to abuse his superiors, using the word "treasonable" in describing their conduct of military affairs. If the conduct of military affairs was so bad that Colonel Mitchell felt he was called upon to make an exposé, there was only one way for him to do this— and that was to resign his commission and carry out his attack in a civilian capacity, which he would be perfectly at liberty to do.

Why is a breach of military discipline so grave an offence? For the very good reason that discipline *of the strictest kind is the* fundamental quality which distinguishes an army from a mob. It is discipline above all that makes an army; and it is of the very essence of discipline that each man shall subordinate himself absolutely to those who by rank are above him.

The moment a member of an army, whether he be private, lieutenant, major, colonel, or of whatever rank, begins to act on his own initiative, and proclaim his own individual views on organization, tactics or strategy, except it be in a communication to his immediate superior, that man becomes a monkey-wrench thrown into the elaborate machinery of the army. He may be perfectly well-intentioned *and have at heart, or think that he has at heart,* the interests of the army and of the nation, but the moment he goes outside of the regulations, he becomes a peril to that very discipline upon which the army is founded.

Water for Next to Nothing

It is not stretching a point too far to say that, next to the air we breathe, a supply of pure drinking water is the greatest necessity of our daily life. Elsewhere in this issue will be found an article on the greatest municipal supply of modern times, as provided by the imposing series of dams, tunnels and aqueducts which conveys pure mountain water over a maximum distance of 120 miles for the supply of the largest city of America. Since sending this story to press, there have come to our knowledge some facts as to the amazing economy with which this great work has been put through and is now being carried on. Every day of the year, there is supplied on an average, to every citizen of New York, 130 gallons of water; and the astonishing fact is that this generous supply costs the individual citizen, on an average, less than three-quarters of a cent per day, or half the cost of a decent cigarette. In these days, when there is so much protest against the cost of our city governments, it is refreshing to find a work of civil engineering which is providing a great public necessity so economically that it is practically as cheap as the air we breathe.

These facts were never so clearly recognized as by the great Washington himself (than whom no one was more sympathetic with the American soldiers of his day) when the shameful neglect of Congress caused his troops to go shirtless and without shoes, and indeed, without food in their hours of dire extremity. Nevertheless, at the conclusion of the war, when the soldiers were called together, presumably by one of their number, to take matters into their own hands and with their swords to force Congress to fulfill its pledges and forthwith grant them their full arrears of pay, Washington, with the true instincts of the soldier, addressed one of his most memorable utterances to the army and pointed out to them, even while he admitted the justice of their complaints, that, if they moved as they intended, they would be guilty of a gross act of insubordination and would rend asunder that discipline which alone distinguishes an army from a mob.

Shall We Abolish the Submarine?

IF the present world-wide agitation against the submarine should lead to an international agreement for its abolition, the embargo will have been due to the ruthless attack which was made by Germany on merchant shipping during the World War. Due to this, the very word "submarine" has taken on very sinister meaning, at least in the minds of the general public and, indeed, to no small extent among naval and military men The dislike of the submarine has been intensified by the many and gruesome fatalities which have happened during the past few years to this type of vessel, culminating in the loss of *M-1*, with sixty-eight men, in the English Channel. A few weeks before that, the world was shocked by the loss of our own *S-51*, with practically its entire crew, and Italy has been depressed by a similar submarine accident. Among naval men, there is a division of opinion; but it is not to be forgotten that the Washington Conference, had it not been for the French attitude, would have committed itself to a total repudiation. If the submarine could be restricted everywhere and for all time to naval warfare, its extreme unpopularity would be modified; although it must be admitted that even in this field, its effect is more moral than practical, for it is a threat and a deadly one. After all is said and done, perhaps the public prejudice, which it seems *impossible to remove*, is similar to that against poison gas, and is based on the ground that it uses what the man on the street or in the field of sport would call "sneak" tactics. Human nature is so constituted that anything which carries this quality is the subject of well-deserved detestation.

Helium as a Life Saver

A CORRESPONDENT, referring to our recent articles on the loss of the *Shenandoah*, complains that we did not draw attention to the fact that the use of helium in the gas bags probably prevented the wiping out of the entire crew of the ill-fated ship. The omission was intentional and was due to the fact that in our own mind, at least, and we think in the mind of the public generally, the fact that the ship was filled with helium was so well known as to need no reiteration. Unquestionably, had *Shenandoah* been filled with hydrogen, the sparks which must have been generated by the severing of electric cables and the tearing asunder of so many metallic members, when the ship was broken into three sections, would have produced an explosion and a conflagration which would have been fatal to every member of the crew. It is true, also, on the other hand, that the superior lifting power of hydrogen and the fact that the substitution of hydrogen for helium would practically double the cruising radius of a ship, are causing airship constructors to search diligently for a substitute for the present type of motors and design a heavy-oil engine which will be free from the risks that are inseparable from the type which is at present in use. Nothing will conduce so greatly to the success of commercial aviation as the production of such an engine with the resulting substitution of hydrogen for helium, except in naval dirigibles.

Especially photographed for the Scientific American by Brown Brothers

Dr Gilbert's envelopes being opened in the presence of newspaper representatives and members of the editorial staff of the Scientific American

Spirit Mediums Fail in Test

DR. J. ALLEN GILBERT, Ph D , of Portland, Oregon, has been conducting a simple but effective test with the co-operation of the Scientific American. It has been a test not of the truth or falsity of spirit messages, but of the truth or falsity of communications received through spirit mediums

More than 300 mediums have sent messages. Of that number 284 revealed what they believed to be a secret countersign agreed upon by Dr. Gilbert and Mrs Gilbert before her death Every one of the entire 284 was wide of the mark.

Mrs. Gilbert (Florence A. Z. Gilbert) died December 17, 1917. For months it had been evident that her death was impending. She and her husband were both deeply interested in psychology and they included among their friends a number of persons who were interested in the phenomena of so-called spiritualism. Neither of them had ever had any experience that convinced them of the possibility of communication with the dead. However, they made a compact that Mrs Gilbert would make every possible effort after her death to communicate with Dr. Gilbert through a medium. To eliminate the possibility of fraud, they agreed upon a certain countersign which must accompany any message purporting to come from her to serve as a guarantee of its authenticity. This countersign was placed in a triply sealed envelope.

After Mrs. Gilbert's death repeated messages, reputedly coming from her, were given to Dr. Gilbert. None of them bore the countersign.

To stimulate further attempts by mediums Dr. Gilbert made a statement on May 30, 1922, through the Portland *Oregonian*, offering a reward of $500 to anyone who would obtain the countersign by communication with Mrs. Gilbert.

The result of that offer was the receipt of 139 definite countersigns, all ostensibly from Mrs. Gilbert. Desiring that a wider effort be made, Dr. Gilbert sought the cooperation of the Scientific American and extended his offer to November 1. Details were published in our August issue.

From all parts of the world messages from spiritualistic mediums were received They came from Japan, Poland, Germany, France, Australia, some of them in foreign languages which neither the doctor nor his wife had ever spoken There were many letters giving communications without any definite attempt being made to give the necessary countersign. A few of the mediums explained that Mrs Gilbert was unwilling to give the countersign because she knew it would cost her husband $500

The True Countersign Revealed

The 284 actual attempts at the countersign covered a wide range from a simple design, such as a cross, to lengthy quotations. Among them were such offerings as "True love lives beyond the grave," a square and a compass, "Jim, I am here, old boy," "Frank, I am happy," "X," "Au revoir, auf wiedersehen," a shamrock with engravings, "I have a crystal vase with white and pink roses, Dear John," "Fiddlesticks," the Twenty-third Psalm, "Hello, Old Boy" "All is well, all is well with my soul," "Amigo," "James, James, James, I am so far away, Death is so wonderful," "I am with you," a peacock feather, "Morphine, A. Z. G. F.," "Separated," favorite photo in a box, "Dear Heart," "Am Happy," "Ave Maria," "Let me sleep," "Never be afraid of the darkness."

The first message received was the first two sentences of the marriage ceremony. The last one, by a curious coincidence, was "Amen." Several addressed Dr. Gilbert as John, Jack, James or Jim, although his first name is Joshua.

All of the countersigns submitted by the mediums were assembled in the library of the Scientific American on November 12, and the triply sealed envelope brought from the vault where it had been resting since the offer appeared in this magazine. Before breaking open this envelope, however, another was read first at the request of Dr. Gilbert. It contained a letter from Dr Gilbert to the editor of the Scientific American. It said in part:

"The true countersign to be opened by you contains three events with dates for the same. In revealing the countersign it might be just as well to state the events without the dates and, if any fraudulent medium claims to have got the countersign without my taking recognition of the same in my report, his fraud would be automatically revealed by the absence of dates and his inability to give the dates, which he would have no means of knowing without a well-nigh impossible investigation"

The second envelope was then opened and found to contain on Dr. Gilbert's office stationery, dated January 1, 1918, this message

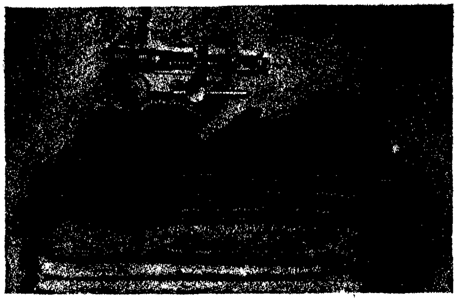
"Before Mrs J Allen Gilbert's death, which occurred on December 17, 1917, she and I agreed upon a certain password to serve as identification of her if she were able to come back to me by any method whatever. The password agreed upon was to be the mention of our three birthdays, viz · Mrs. Gilbert's, Dorothea's (our daughter) and mine. (The three dates are here named) Request has been made of Dr. James H Hyslop, 519 West 149th Street, New York City, New York, that he should attempt to get in communication with Mrs. Gilbert through Mrs. Chenoweth, if possible. Nightgown sent to him as an aid in that attempt Signed J. Allen Gilbert." Dr Hyslop was a distinguished psychic investigator, whose death occurred some time after the password was sealed.

After being read, this note was again placed in a sealed envelope and returned to the vault None of the mediums had stated what it was If any hereafter should allege communication with Mrs Gilbert, there still remain the three dates to serve as a password.

Thus is completed a test of spiritualism pure and simple The part played by the Scientific American has been as an aid to Dr. Gilbert in his effort to receive a message from his deceased wife, if such messages are possible Whether it proves or disproves anything we leave for the reader to judge It should not be confused, however, with the larger field of psychic research, nor with the investigation of so-called supernormal phenomena this publication has been interested in for the two past years

EXTERIOR VIEW OF THE OIL FILTER

It consists of layers of fine wire screen and felt filtering material. A valve permits of the oil circulating without passing through the filtering material if the latter becomes clogged



INTERIOR VIEW OF THE OIL FILTER

This view shows the wire screen and filtering material. The by-pass, by means of which the filter is cut out of the line of circulation, in case of stoppage, is also shown

Comfort from Your Motor

By H. W. Slauson, M.E.

I MEAN exactly what I say by that title, not comfort alone from low-pressure balloon tires, long, flexible springs, quick-acting snubbers and shock absorbers, or rich and luxurious upholstery and seat cushions, *but real comfort from within the motor itself.* That is the one big, outstanding development of 1926 motorcar design, and constitutes one of the most important chapters of the romance of the automobile industry.

Up to a few years ago, the gasoline power plant that drives our automobiles could hardly be looked upon as a source of comfort. It developed the power of some ten to fifty horses, and as such was expected to produce as much noise and exhibit as much temperament as at least a team of high-spirited horses. Then came improvements in design which reduced the factor of temperament almost to the vanishing point and made the modern internal-combustion motor one of the most reliable power sources yet developed. Supplementing these mechanical improvements, which produced greater reliability, was a marked reduction in the amount of noise generated by the motor—for, with the exception of the exhaust, noise means friction and wear, and where these are reduced, an approach to silence follows.

Vibration Due to Lack of Balance

But even this approach to silence did not last long, for vibration and wear will soon throw a motor out of "tune" and not only does vibration produce wear and make a motor noisy, but the sensation which it conveys to the occupants of the car is not pleasant.

Vibration is due to a lack of balance or stability when an impulse is applied to any material. Vibrations may vary in time or period from the slow, steady beat of a long pendulum, to the infinitely rapid shiverings of the high pitched tuning fork. Now the moving parts of a gasoline engine are naturally unbalanced, for the crank, connecting rods, and pistons constitute unequal weights throughout various portions of the revolution of the crankshaft and flywheel. Fortunately, this apparent unequal distribution of weight may be overcome in some types of engines by so arranging the cranks that when one mass of cylinders and connecting rods is moving upward, an equal mass will be traveling downward.

In the case of those crankshafts which cannot be thus balanced, however, resort may be made to the use of additional counterweights or balances, which will exactly offset the amount of the weight on the other side of the crankshaft. Machines have been developed which will balance these crankshaft assemblies almost to the weight of a postage stamp, and the flywheel, crankshaft, connecting rods and pistons of an engine so balanced, may be run by an external source of power, at almost any speed within reason, with no ensuing destructive vibration.

But note that I said that such an assembly may be run by *external* power. As soon as we introduce the tremendous impulses of the explosions, or rapid combustion rather, on which we are dependent for the generation of power within our gasoline engines, we face an entirely different set of conditions. Consider that one piston of a four, six, or eight-cylinder crankshaft assembly is suddenly struck a tremendous blow of five or six hundred pounds. There is a natural lag, or inertia, in the rest of the crankshaft and its assembly, which prevents it from responding instantly to this tremendous explosive force, and there is therefore a twist, or winding, of one part ahead of the action of the remainder of the crankshaft assembly. If we balance a board across a saw-horse, and suddenly push down on one end, the other end will rebound upward it is true, but not until a very considerable distortion has taken place in the plank, and when this other end does spring upward, it goes farther than the original end, because of the energy stored by the springiness of the board.

A CENTRIFUGAL TYPE OF AIR CLEANER

The dust filled air enters through the outer ring. The vanes and baffle plates impart a swirling motion to the air. The direction of the clean air is reversed and it enters the carburetor from the opening indicated by the white arrows

Therefore, we cannot consider even a heavy, steel crankshaft to be solid and inflexible when dealing with the causes of vibration. There is an infinitesimally small twist or whip to any crankshaft when subjected to these tremendous impulses generated by the explosions in the cylinders. At most speeds this vibration may not be apparent, or it may be neutralized by other conditions. At other speeds, however, possibly within a limit of but two or three miles per hour, the vibration may become so apparent as to transmit a violent shaking to loose fenders, lamp brackets, hood catches, and the like until the entire car seems to be suffering with St Vitus's dance. The speed at which this violent vibration occurs is known as the critical speed, and the motor is said to possess a "period" of vibration.

Increase in Number of Bearings

Obviously, one of the most logical ways to overcome this is to furnish the crankshaft with as much rigidity and stiffness as possible, in order to prevent distortion. This can be accomplished by making the crankshaft large and heavy, and by supporting it by means of large main bearings at frequent intervals throughout its length. This furnishes a resistance and stiffness to the whipping and distorting effect of the impulses in much the same manner as a light, flexible plank will be made to give less when we walk upon it if it is placed over beams which are set close together. Thus, the crankshaft of the new cars are not only larger than might be found previously, but are plentifully supplied with bearings, and in many instances we find five-bearing four-cylinder motors, seven-bearing six-cylinder engines, and the crankshaft of eight-in-line power plants supplied with nine main bearings.

Fortunately for designers and motorists, vibration can be neutralized or absorbed. A swing, or other pendulum-like object, furnishes an excellent illustration of slow vibration. A small child can swing a heavy person high, if he gives a slight push at exactly the proper time. On the other hand, if he pushes at the wrong time, he can easily stop the swinging eventually, by neutralizing it.

Vibration is thus the compounding of a series of impulses, timed in exact accordance with the period of the vibrating beat.

Motorcar engineers have analyzed the cause of crankshaft vibration, and have installed neutralizing devices which, with the changes in design already outlined, have served practically to eliminate this heretofore annoying adjunct of motoring. One type of device is built within the crankshaft itself, and consists of a pivoted bar placed along one of the crank arms. Each end of this short bar is kept from direct contact with the crankshaft arm by means of a flat steel spring. This pivoted bar, of course, revolves as a part of the crankshaft and through its ability to change its position slightly, when the rapidly-turning crankshaft is twisted out of position by the impulses of the explosions, serves to neutralize or absorb the vibrations that would otherwise be set up.

One of the most effective means of absorbing vibration consists of "dampers" in the form of friction disks, or revolving weights which serve wonderfully well to smooth out the inherently rough portions of the period.

As drops of water will wear away the hardest stone, so will constant vibration set up a rapid deterioration in the mechanical parts of the car.

The Importance of Oil Filters

But vibration is not the only cause of wear in an automobile. Wear is caused by friction, and friction occurs whenever fabric or metallic parts move in direct contact with each other. It is the purpose of lubrication to interpose a film of oil between all moving surfaces, and thus to reduce friction to a minimum. Properly designed lubricating systems perform this function wonderfully well, provided the oil can be kept clean and of the proper consistency or body. The oil is the very life blood of the motor, for it circulates to every vital part. Therefore, if this life-preserving fluid carries disease germs in the form of dirt, grit, or other foreign substance, the very purpose of the lubricating system will be defeated. Consequently, it may well be stated that the second most important development of automobile motor comfort consists of the attachment on many of the new cars of devices for reclaiming or rectifying the crankcase oil and for preventing the entrance into the engine, through the carburetor, of dirt and dust.

NEW TYPE OF CRANKSHAFT BALANCER

A flat spring keeps each end of a pivoted bar away from the arm of the crankshaft until a vibrating force occurs in the latter. Then one spring or the other is depressed and a counter force is generated which absorbs this vibration

Oil purifiers are more necessary now on automobiles than was the case ten years ago when the gasoline then used for fuel was easily vaporized, and excessively rich mixtures were not needed for starting a cold engine. Today's fuel vaporizes at a much higher temperature, and this means that the rich mixtures required for starting are easily condensed into a liquid which runs down the walls of the cylinders, and into the crankcase oil. This liquid fuel, therefore, not only dilutes the lubricant in the crankcase, but during its passage down the cylinder walls, it washes with it the dirt and dust which may have been sucked in through the carburetor. Particles of carbon which will be loosened from the piston and cylinder head, may also be washed down into the reservoir containing the lubricant. This foreign matter, when circulated with the diluted oil, forms an excellent cutting compound similar to a valve-grinding material, with the result that the bearings and other moving parts of the engine, instead of being thoroughly lubricated, are ground away by the very means intended to prevent wear.

In order to reclaim the oil thoroughly, therefore, the oil purifiers now found on many of the new cars serve two purposes. The first is to filter the foreign matter from the oil by forcing it through various thicknesses of filtering material and fine mesh screen. The second is to subject this oil to sufficient heat from the exhaust of the motor to drive off the condensed gasoline and return it, in the form of fuel, to the intake manifold of the engine. The lubricant is thus restored to its former efficient state, and when so treated, does not require replacement or renewal more than once every thousand to three thousand miles, depending upon the efficacy of this treatment. The oil purifiers are generally in the form of a small circular or square tank, piped to the intake manifold and crankcase of the engine. The purifier is not always placed directly in the oil-circulating system of the engine, for its capacity might not meet the total, full-power requirements of the engine. The entire amount of oil in the crankcase, however, is passed through it at frequent intervals, the necessary force sometimes being obtained from suction which is secured from the intake manifold near the carburetor.

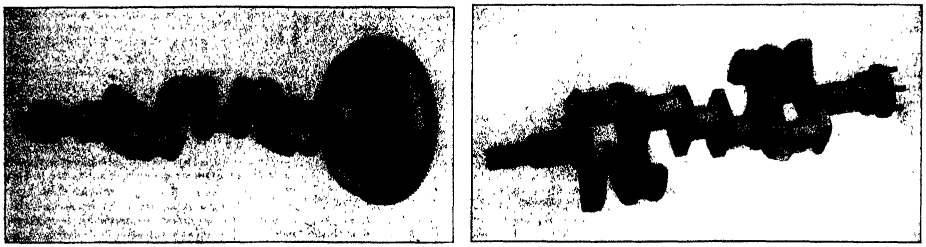
But of equal importance with reclaiming the oil is the prevention of the entrance of the dust and other abrasive foreign matter, which is a part of each breath of air taken by the motor.

It might seem to be an easy matter to cover the air intake opening of the carburetor with a series of screens and filters which would catch all of the foreign matter contained in the air passing through. We cannot afford to starve the engine, however, by placing too much resistance in the path of the air which it demands. The air is not forced into the engine under pressure, but is sucked in by its own suction pump efforts, and if the cylinders have not been filled by the time that the piston reaches its downward stroke and the intake valve has been closed, the engine will not have received its full charge of explosive mixture, and we cannot expect full power and efficient results. Therefore a large filtering area with many passages must be provided or the dirt must be thrown out because of the difference in weight between it and the air which is carrying this foreign matter.

Vibration and Friction Greatly Reduced

This second system is known as the centrifugal type. By means of baffle plates, vanes, and in some instances, small rotating fans, the incoming air is given a rapid whirling motion, similar to that imparted to the milk in a cream separator. Through one of the primary laws of physics, the heavier dust and dirt is thrown outward, and is caught in a trap, or expelled directly into the outside air. The incoming air, thus freed of the heavier particles of foreign matter, passes into the cylinders of the engine in a comparatively harmless form. Another ingenious system of air purifier employs a connection with the exhaust pipe of the engine to create an injector effect to blow the trapped particles of foreign matter from the air cleaner directly into the outside air.

No matter how easy its riding, the car in which oil must be changed every four or five hundred miles, carbon removed every two or three thousand, bearings tightened or replaced every ten thousand, and a general overhaul given every twenty thousand or so miles of travel, cannot be a real comfort and pleasure to its owner. Therefore, the marked reduction of engine vibration and the very thorough protection of all moving parts against friction, created by inadequate lubricating materials and the entrance of foreign matter directly into the very vitals of the engine, may well be looked upon by owners, as well as by engineers, as two of the most important advances in the past fifteen years of motorcar development.



FINE COUNTERBALANCING IS ACCOMPLISHED BY TWO MODERN CRANKSHAFTS

A six-cylinder crankshaft, with a new type of balancer attached at the left-hand crank throw

In this, a special machine drills holes in the counterweights till balance is attained

American Eclipse Expeditions to the Far East

The Total Eclipse of January Fourteenth Should Teach Us Much About the Sun

By Henry Norris Russell, Ph.D.
Professor of Astronomy, Princeton University
Research Associate of the Mt Wilson Observatory, California

THE chief astronomical event of the present month is undoubtedly the total eclipse of the sun, which happens on the 14th Although similar to the eclipse of the year before in the essential feature that the moon's shadow reaches the earth, and plunges the regions which it traverses into darkness, it is curiously unlike it in detail Last year's eclipse was visible only in the western hemisphere, this year's will be visible in the eastern The former was observed in the bitterest cold of winter, the latter will be seen in the endless summer of the tropics The earlier eclipse passed over densely peopled regions, and it was seen by millions of well-informed people, the forthcoming one can be seen only in thinly settled and primitive lands where few of the inhabitants will understand its full meaning.

The moon's umbra first reaches the earth as the sun is rising in Central Africa Sweeping across north of Lake Victoria, it passes out to sea, just south of the equator, and for four thousand miles traverses the Indian Ocean. Coming to land again in Sumatra, it crosses the southern part of this island, traverses the whole width of Borneo, reaches the island of Mindanao in the Philippines, and then loses itself in the Pacific. The region within which a partial eclipse is visible extends over the eastern half of Africa, and includes Arabia, India, China and northern Australia.

American Eclipse Expeditions Will Go

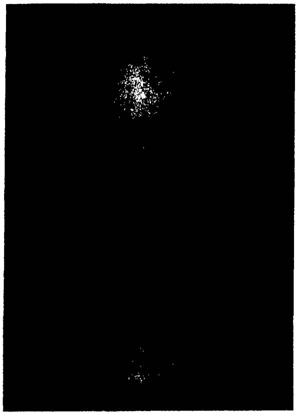
The eclipse is a long one. The maximum length of totality—four minutes and ten seconds—can unfortunately be observed only in the Indian Ocean, but a duration of three minutes and twenty seconds can be secured on the west coast of Sumatra. The best observing stations are in that region In Borneo and the Philippines, the sun is much lower in the sky and the duration shorter, and conditions on the west African coast are no better Weather probabilities are, however, none too favorable, although these again are best in Sumatra.

Despite these uncertainties, and the great distance, several astronomical parties are on their way to observe this eclipse. Two are American—one from the United States Naval Observatory, including also Dr. Anderson from Mt. Wilson, and another from the Swarthmore and Allegheny Observatories, under Dr. Miller and Dr Curtis. A Dutch and a German party are also en route

The proposed program of observations is a long one. The sun will be high in the sky in Sumatra and conditions will be favorable for another observation of the "Einstein" effect—the bending of rays of light which pass close to the sun Although the results of the Australian expeditions really settle the matter, one more good set of plates would make assurance doubly sure.

The corona will be photographed with instruments of long and short focus, showing—if the skies favor—what changes in its form accompany the increasing abundance of sun-spots. Spectroscopic observations will not be neglected, and both the outer and inner envelopes of the sun will receive due attention

Among the most important of such observations are those of the "flash spectrum." Just after the moon has hidden the brilliant disc of the sun, the sun's atmosphere is still visible, rising several hundred miles, and appearing to the eye as a brilliant steel-white line along the dark moon's edge. Photographed through a prism—or with a concave grating—the light of this atmosphere gives a perfect line of information about the sun. One must work quickly, for in a few seconds the advancing moon covers up the sun's atmosphere altogether; but exposures by a watchful observer can be timed just right Even better, perhaps, is an automatic device which records, on a moving plate, the whole sequence of changes in the spectrum, from the time when the bright surface of the sun is still strongly visible until the atmosphere is quite covered by the moon.



APPROACHING "SECOND CONTACT"
As the moon's shadow thins the sun's waning disc, the astronomers will stand at their stations All is ready

The spectrum of the glowing gases of the solar atmosphere consists, as might be expected, of bright lines, matching the dark lines of the ordinary solar spectrum, but some of these lines are emitted only low down in the atmosphere, close to the photosphere, and appear on the photographs as narrow, short images, while other lines, which are emitted high up as well as low down, give long and broad "crescents"—that is, images of the crescent-shaped arc of solar atmosphere which rises beyond the edge of the dark moon.

The beautiful observations of Professor Mitchell in 1905 and 1925 show that the height to which the same lines were visible was not the same in the two cases, and further observations, perhaps at many eclipses, will be needed to confirm this variation, and study its laws. The moving-plate apparatus will furnish important information, telling us which lines brighten up first, as the sun itself observed, as well as which are the first to fade away.

From the existing observations, it appears that the sun's atmosphere is very extensive. The lower part, in whose spectrum practically all the bright lines are to be found, rises some two hundred miles above the photosphere. In the next few hundred miles most of the lines fade out, but the stronger ones, even of heavy metals like titanium and iron, rise to 800 or 1,000 miles. A few lines go much higher, up to 4,000 miles, and a very few—belonging to hydrogen, helium, and calcium, rise to 8,000 miles, all around the sun, forming the chromosphere—and above this again to great altitudes in the prominences.

These unquestioned facts raise many difficult problems. How much material is there in this great atmosphere of the sun? Why does it rise so high, in spite of the powerful force of gravity at the sun's surface, nearly twenty-eight times as great as on earth. Above all, why do heavy atoms like those of calcium rise as high as the far lighter ones of hydrogen and helium?

First, as regards the quantity of gas in the solar atmosphere, the independent work of several investigators—Milne at Cambridge, Miss Payne at Harvard, and Stewart and the writer at Princeton—show that the pressure and density must be very low.

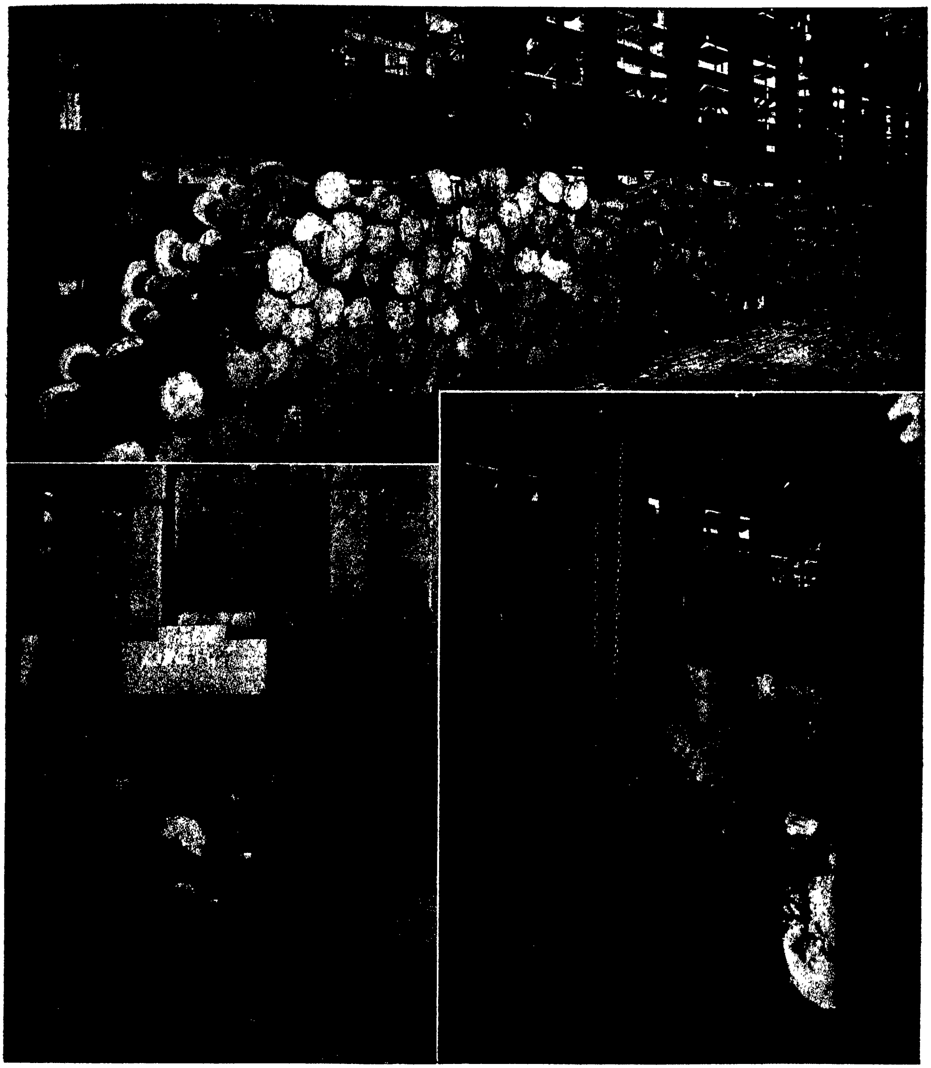
The Powerful Pressure of Light

When the gas has a hundredth of the pressure—and, at its high temperature, less than a thousandth of the density—of ordinary air it must be rendered hazy by various processes involving the inter-action of electrons, atoms and light-waves, so that on the scale of solar phenomena, it would appear opaque and be part of the brilliant photosphere. Indeed. Milne's latest calculations indicate that this would happen at a density a hundred times lower still. The transparent atmosphere above this level must be of extreme tenuity At the maximum, there can hardly be more gas above the photosphere than would make, if compressed, a layer as dense as air and ten feet thick. At the minimum, the thickness of the corresponding layer may be only an inch.

A few feet or inches of air, then, expanded to form a layer hundreds of miles deep—this is the conception of the sun's atmosphere to which modern physics leads us.

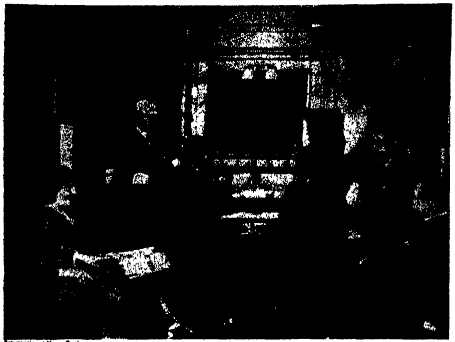
One may wonder how so thin an atmosphere can absorb the lines of the solar spectrum; but the outer vapors of an electric arc, charged (for example) with sodium, although but a fraction of an inch in thickness, can absorb the sodium lines more strongly than the sun's whole atmosphere does—as direct comparison shows. This, then, need not trouble us. But by what means is this minute amount of gas expanded into an atmosphere a thousand miles and more in depth? The very high temperature accounts for a good deal, but even more important is radiation pressure. The intense outgoing flood of light from the sun tends to drive along with it any obstacle. On a body as big as a pebble, this effect is insignificant, but on such a tiny thing as an atom, it may be great enough to balance even the sun's great force of gravity, if the atom absorbs even a small part of the sun's light.

Above the lowest layer, in which all the lines are found (and perhaps to some degree in this layer too) radiation pressure must be the main factor in keeping the sun's atmosphere from settling down closer to the visible surface. The calcium atoms (which absorb the two strongest lines in the whole spectrum) must be exceptionally subject to this influence, and hence it is not surprising that they rise as high even as hydrogen.



Steps in the Manufacture of the All-important Rear Axle

The strength of an automobile depends largely upon the strength of the rear axle. In these photographs, furnished us by the Timken Axle Company, the first step in the process of manufacture is illustrated. TOP: *Drop forgings ready for machining. Accuracy in forging saves much time and metal in the finishing process, where every motion and every minute is figured down to minimum.* LEFT: *This rear end forging is being removed from the dies which have formed it, to dimensions allowing for the right finishing cut. Machines are often named or some humorist leaves his mark thereon.* RIGHT: *Steel ingots at just the proper temperature are roughly blanked out in the drop forge. The accuracy attained in the operation of the hammer is amazing, deft stunts being sometimes performed for interested visitors. After finishing each piece, the dies are cleaned out by compressed air.*



International News Reel

LISTENING IN ON THE BROADWAY LIMITED

Picking up concerts in a railroad car is much easier than is the work of transmitting messages from moving trains

Wide World

GERMANY'S SUBURBAN TRAINS ARE RADIO EQUIPPED

Several trains leaving Berlin carry radio receiving apparatus. Headsets at the seats permit the passengers to listen in

Giving Trains a Radio Voice

Wired Wireless Is Apparently More Adapted for Service on Railroads than Is Space Radio

By Orrin E. Dunlap, Jr.

EVER since ocean voyagers have been able to communicate with their homes, travelers have wondered why the railroads have not utilized radio for the convenience of passengers and for train dispatching. The truth is that numerous experiments have been conducted by the railways, but radio engineers in signaling from moving trains have been confronted by difficulties not prevalent on board ship.

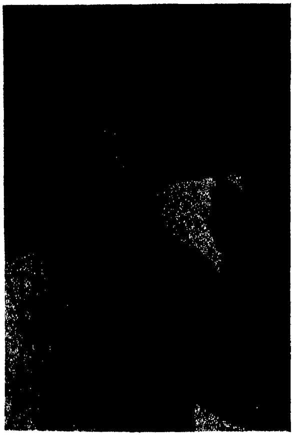
Radio service on trains has been handicapped, because the aerial must necessarily be low in order to pass tunnels and other clearances. This dwarfed antenna will intercept broadcasts, but it is not efficient as a means of radiating Hertzian waves. Aerials on top of trains are likely to be directional and the signals fade when the cars pass around curves, because the direction in which the wire points is changed. The Louisville and Nashville Railroad found that a single wire strung around the dome of the roof and clearing the dome by four inches was most efficient. The antenna was tapped and lead-ins run to the interior of the cars. Care must be taken that the dome of the car does not shield the wire, because the permissible location of the antenna in relation to the roof is confined to a small space.

Transmission Poor on Trains

The surroundings of a train differ every second. One location might be ideal for radio transmission, but a few minutes later the aerial is likely to be shielded by a mountain or by woods. An hour later it may be in the center of a city. A ship's radio installation does not have to contend with these varying conditions.

Short-wave transmitters have also been tested on moving trains, because this type of apparatus does not require a long aerial, but there is a "dead" area around the low wave station. Although short waves travel long distances, they are not dependable for such short-distance communication as might be needed from train to train or from train to station.

The Delaware, Lackawanna and Western Railroad conducted experiments in 1914 with radio on trains running between Hoboken and Buffalo. During the past summer the Great Northern Railway made tests to determine the feasibility of dispatching trains over the Rocky Mountains by radio, chiefly for emergency use during severe winter weather, when interference is encountered in the operation of telegraph lines through the mountain region. Reports stated that the tests were not successful, because of static and other obstacles to reliable communication.



Underwood & Underwood

RADIO SUPPLEMENTS THE TRAIN WHISTLE

The engineer on the Virginian Railway pulls a cord which automatically sends a wired wireless signal back to the helping locomotive. The reply or acknowledgement comes in a similar way through the loudspeaker in the cab

The Canadian National Railways has ten broadcasting stations scattered across the Dominion and the trains are equipped with receivers to entertain passengers. Headphones hang near the seats in some of the cars, so that anyone may listen without disturbing others, as would be the case if a loudspeaker were used. Another advantage of the headset is that it excludes external noises caused by the train in motion.

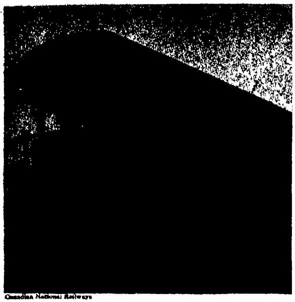
The Midland Scottish Railway, in England, is investigating the possibilities of communicating from moving trains, and it is hoped that it will be practical to send and receive messages on the Scottish Express and other crack trains of the line, and possibly effect telephone communication by relay through an ordinary telephone exchange.

No Tuning Necessary

Some engineers have turned their attention from space radio to wired wireless, or carrier-current telegraphy, as a means of signaling from trains. This method employs high-frequency current, but instead of the energy being broadcast, it is guided over existing conductors, such as trolley wires, power lines, metal pipes, the third rail, and telegraph or telephone wires.

Although wired wireless is more limited in scope than space radio, it has numerous advantages which make it particularly suited for service on trains. It requires less power, because the energy is not broadcast; there is less chance for interference from static or from radio stations; if the conductors are broken during a storm, and if the gap is not too big, performance of the wired wireless system is still possible; it does not interfere with the regular duty of wires over which the carrier current is sent. Furthermore, wired wireless is not classed as a radio installation. Therefore, a government operating license is not necessary and an operator is not required to be on watch at all hours. The carrier current transmitter is only in operation when the operator is signaling. This effects economy in tubes and power.

The basic electrical features of regular broad-


Canadian National Railways

RAILWAY RADIO IN CANADA

A library-compartment car of the transcontinental service, Canadian National Railways, equipped with radio receiving apparatus, showing the manner in which the antenna is erected. There are forty cars of this type in service

casting equipment and wired wireless apparatus are identical. Standard instruments and vacuum tubes are employed in both cases. Two different frequencies are used in wired radio to permit duplex operation, that is, the same as over the telephone.

The aerial of a wired wireless system is placed close to a high-tension or trolley wire. The high-frequency current is thus superimposed upon conductors, and receivers scattered along the route, connected with antennas in close proximity to the elevated wires, detect the messages. No tuning is done. All adjustments of the transmitter and receiver are made previous to installation.

The latest automatic system of wired wireless communication for railroads has been developed by the Westinghouse Electric and Manufacturing Company, for the Virginian Railway, for the purpose of establishing communication between the front and rear of long freight trains, some of which are a mile in length.

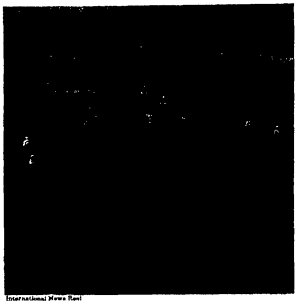
The route of the Virginian Railway passes over the Alleghany and Blue Ridge Mountains and a section of the course operates on a two percent grade, with many curves and tunnels. This portion of the road has recently been electrified to permit more rapid handling of trains on the heavy grades. Generally, one locomotive is used at the head of the train and a helping engine at the rear. The problem has been to secure synchronous action between the two locomotives, especially in starting and stopping. Air whistles used on electric locomotives do not carry as far as steam whistles used on steam engines, so it became necessary to devise a new signaling system for the electrified road.

Wired Wireless Solves the Problem

Tests with wired wireless showed that it would solve the problem, and permanent installations were made. The trolley wire is used as the conducting medium, making it necessary to equip only the engines and cabooses. The transmitter and receiver are mounted in steel boxes, rigidly built to withstand vibration. A motor generator driven either from a storage battery or from the source of power supplied to the electric locomotive, furnishes the high-voltage output for the plate supply to the transmitting tubes. The transmitter consists of a 50-watt master oscillator tube operating two 50-watt power amplifying tubes connected in parallel. The receivers comprise the necessary tuned circuits, a detector and two audio-frequency amplifiers.

The Virginian's equipment was designed for telephony and signaling, but it is arranged only for signaling. A small control box is attached to the ceiling of the cab and a cord which hangs out of the box is handled by the engineer in the same manner that he would handle the whistle cord. When the engineer desires to signal, he pulls the signal rope half way out of the control box. This starts the motor generator and sends high-frequency current out over the wires. He then pulls the rope all the way down and the output is modulated by a 500-cycle modulator, producing a whistle-like note in the loudspeaker at the other end of the train. The code is similar to that used for whistling on railroads. The message can be acknowledged and communication carried on in the opposite direction.

Germany is developing a system of wired wireless whereby passengers on railroads will be able to telephone to any telephone number in Germany and also be reached by telephone from any point in the country. The plan is to have a central station, whence connection will be extended to any home or office possessing a telephone. Likewise, anybody telephoning to the central station can reach the express trains and ask for any passenger, who will then be paged and taken to the train's radio station, whence he can talk with the person calling, exactly as over the ordinary telephone. Only a few minutes are required to get a connection with Berlin. The toll does not exceed that of an ordinary long distance phone call of equal length. Telegrams will also be handled by the train's radio station. Passengers can drop a coin in a slot in front of their seats, whereupon they will be provided with a headset to pick up concerts and news.


International News Reel

AERIAL WIRES ON THE D L & W TRAINS

This is the method first used by railroads in erecting antennas. The necessity of keeping the wires close to the steel roof of the car, because of tunnels and other clearances, reduced efficiency and the system was not adopted

American telephone officials have expressed the opinion that the German system is not commercially practicable in the United States, because of the maintenance expense, and the public seems to find its needs met by the telegraph facilities at each station *en route*. Furthermore, they claim that the speed of American trains makes sending of messages unnecessary.

International News Reel

ONE OF THE FIRST RADIO INSTALLATIONS ON TRAINS

In 1914, the Delaware, Lackawanna & Western Railroad equipped one of their trains with this apparatus to communicate with their stations at Hoboken, Binghamton and Buffalo. Amateurs along the route often talked with the train

Wide World

RADIO CONCERTS FOR CANADIAN RAILWAY TRAVELLERS

If the broadcast is of interest to all passengers in the club car the loudspeaker is switched into the circuit. Otherwise, headsets are provided each traveler, so that the radio will not disturb those who do not care to listen in

Courtesy of the American Museum of Natural History

The extinct sabre toothed tiger of the Pliocene Epoch His jaw could open abnormally, exposing the scimiter like upper canine teeth which had developed into great tusks

Men of the Early Glacial Epoch

In England, Flint Implements 500,000 Years Old Have Been Found

By J. Reid Moir

President of the Natural History Society of Ipswich, England

EVEN before the first advance of the great glaciers which during half a million years alternately crept over the northern part of the earth and melted back again, East Anglia, a part of eastern England, was peopled by primitive races of men about whom we know only what may be inferred from the crude flint implements they left, but about whose environment the fossils of plants and animals, buried in strata of this far-off period, tell us much of value This was the Pliocene Epoch.

Then came the Pleistocene, or glacial, Epoch, with its deep cap of ice which invaded most of England. It drove man out, presumably, for we lose sight of him for perhaps 100,000 years. But when the ice had again melted back far enough to expose the soil of England during the first interglacial stage we find other evidences of early man; and in Germany, from which the England of that distant time was not then separated, we find the famous jawbone from Heidelberg, massive and thick, indicative of a powerful race It is, then, of these two times that our present story treats

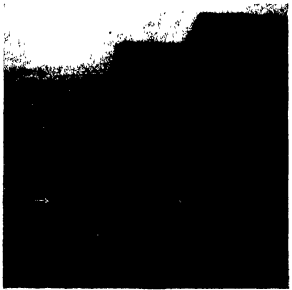
When England Was Sub-tropical

If we could have visited East Anglia towards the close of the warm Pliocene Epoch we should in all probability have seen a country of wide plains, well watered with lakes and rivers, and supporting a large and varied series of animals We would have witnessed the movements of great herds of the mastodon, a remote ancestral form of the modern elephant, the hipparion, a three-toed ancestor of the horse, ancient types of rhinoceros; and hyaena, the giant beaver, deer, and other creatures which have long since become extinct. These animals are such as could only live in a warm climate So we know that Eastern England was enjoying sub-tropical conditions towards the close of Pliocene times

But, though we would have been deeply interested in the mammalian life of the ancient East Anglian land surface, yet this interest would have been entirely eclipsed by the excitement experienced if we had come suddenly upon a party of the prehistoric people of those days.

There is no doubt that these remote ancestors of man would not have been over pleasant to look upon, as they must have exhibited many ape-like characters in their forms and features. We may imagine them as of low stature, very strong, with immensely long arms, and large hands Their bodies were clothed in hair, and their skulls were long and low, while their jaws projected, and contained canine teeth almost as prominent as those of an ape.

It is upon such a party of early men that we have now come in our journey over Pliocene East Anglia, and we observe they are engaged in breaking up large masses of flint, and shaping them into implements of various kinds. The majority of the flints are fractured by means of smooth, heavy, well-rounded hammer stones which are held in the hand



Courtesy of "Natural History" and the author

CLIFF AND FORESHORE NEAR CROMER

As the present North Sea erodes this cliff away, new sources of early Stone Age implements are exposed

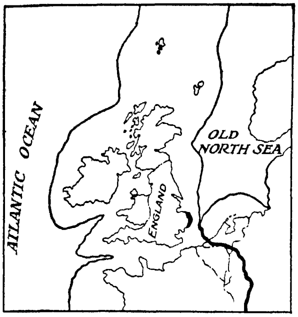
We notice that these ancient flint flakers are adept at removing large flakes of flint by means of very strong and skilful blows, and that these flakes are quickly and dexterously trimmed with smaller hammer-stones into implements for scraping, chopping, and piercing purposes. We see also that some of the implements are very large and are shaped at one end like the beak of a bird of prey, and we realize what formidable weapons these would be in the hands of these savage and determined men.

Arrival of the Glacial Epoch

It is very necessary that they should possess such weapons, for every day and every night these people are in danger of sudden death from the fierce carnivorous beasts that lurk in the surrounding scrub and jungle. Also they have to provide themselves with food, and for this purpose they need large and heavy flints, equipped with a cutting edge, in order to dispatch powerful animals like the mastodon, that have been trapped in pits and other places. Around the encampment we see the remains of the creatures killed and eaten, and on one side, the ashes of a fire are visible, with several flints, cracked and reddened by heat, lying near it.

In the course of time East Anglia began to sink very slowly, and as the sea gradually encroached upon the land, the flint implements and other remains of man were quietly washed into hollows and depressions, where they were finally covered by great and widespread deposits of marine sands and shells. In the eastern counties of England these beds are known as "crag," and when visible in excavations of various kinds, their deep red color is one of the most arresting features of the landscape.

It is evident that as the land began to sink, the climate of East Anglia was growing colder, for an examination of the fossil shells in the crag has shown that, as we proceed upward from the lower



BEFORE ENGLAND WAS AN ISLAND
400,000 years ago man roamed on land that is now beneath the waves of the North Sea. East Anglia is shaded

and older to the upper and later layers of this bed, more and more cold-water molluscs make their appearance, until in the uppermost portions nearly all the contained shells are boreal species. This period of cold represents, in Suffolk and Norfolk, the beginning of the Great Ice Age, during which, at certain intervals—which were separated by warm inter-glacial phases of long duration—immense ice-sheets overflowed East Anglia.

Following upon the deposition, during the ice invasion, of the sands and shells of the Crag Sea over the ancient land surface of Pliocene times, the land began to be uplifted again, and thus the curtain rises on another remarkable chapter in the early history of our race Thus, as the upheaval progressed, what is now the North Sea was banished far to the north of its present position Then it was that the river Rhine flowed northward through a wide and shallow valley which is now occupied by the sea, and laid down its deposits of detritus upon the surface of the exposed beds of crag

This material, deposited by the ancient Rhine, is known as the Cromer Forest Bed, and it contains a great number of the remains of trees that flourished in those remote days. An examination of the fossils contained in the Cromer Forest Bed has shown that the Rhine valley of that remote day was inhabited by herds of warmth-loving animals and it is therefore evident that the climate had once more become genial. The fossil bones and teeth of the great southern elephant, and *Elephas antiquus*—together with those of extinct sabre-toothed tiger, and of bears, numerous deer, horses and hippopotamuses—all of which have been found in the Forest Bed—testify to this return of warmth

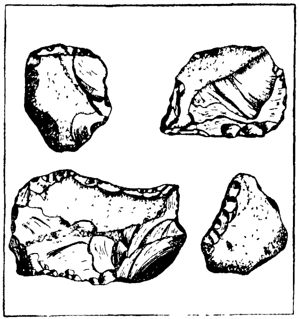
Finally there have been found at the very base of the Forest Bed, overwhelming proofs that prehistoric man inhabited the ancient Rhine valley, of which the present eastern slopes of England then formed a part, and the River Thames a tributary, and that he made his implements from the vast quantity of first-class flint that lay there ready to his hand.

These ancient Cromerians had evidently advanced considerably beyond the state of the still more ancient people who lived before the Crag was deposited We know this because we see that many new and improved types of implements make their appearance in the more recently deposited Forest Bed These specimens take the form of skilfully made choppers, points, and hand axes, and are remarkable for their great size Some of these implements weigh as much as seven and one-half pounds, while some were flaked for prehension, to the immense size of the hands of their makers

The Earliest Authenticated Evidence of Man

Before the author of the accompanying article began his researches we knew of the existence of man only in the glacial period; but now science has accepted the authenticity of human cultures found in strata that were formed before its beginning—that is, in the last, or Pliocene, epoch of the Tertiary Period of geology. These evidences are known, respectively, as the Foxhallian and Cromerian cultures and they have been worked out chiefly by Mr. Moir in southeastern England.

No one with any knowledge of flint flaking can examine the Cromer specimens and fail to be impressed with the fact that the men who made them must have been capable of delivering blows of great strength and skill in the manufacture of their implements, nor to realize that they represent a very definite stage in the evolution of the human race

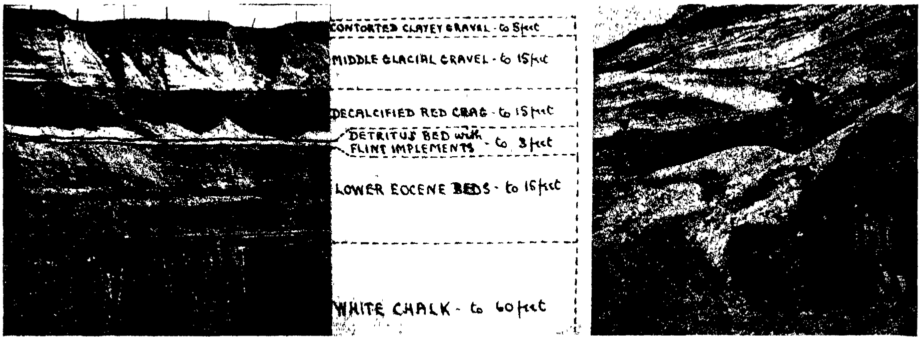

Courtesy of "Natural History" and the author

AMONG MAN'S EARLY EFFORTS AT TOOL MAKING
These implements, ranging in age from pre glacial to early glacial, show cutting edges retouched by human hands

Some years ago there was found at Heidelberg, in Germany, at a depth of about eighty feet from the surface, a massive human lower jaw-bone, which exhibits many distinctly ape-like characters. So large is this specimen that it is clear the individual to whom it belonged possessed almost gorilla-like proportions, and the interest in his fossil jaw-bone is enhanced when we learn that it was found in a stratum of the same age as the Cromer Forest Bed.

Here then, it would seem, we have part of the skeleton of one of the same race of men who made the great flint implements found in Norfolk, and who hunted big game in the great ancient Rhine valley several hundreds of thousands of years ago

To stand upon the foreshore at Cromer, and visualize the vast changes in the earth's surface that have taken place since the days when man and the sabre-toothed tiger battled for existence upon a now deeply buried land surface, is to realize the profound antiquity of the human race We do not know the exact number of years which these changes occupied, but we may be sure that it was immense, and that the earliest prehistoric men of East Anglia are separated from us who live today by a great and undoubted gulf of time


CONTORTED CLAYEY GRAVEL - to 5 feet
MIDDLE GLACIAL GRAVEL - to 15 feet
DECALCIFIED RED CRAG - to 15 feet
DETRITUS BED with FLINT IMPLEMENTS - to 3 feet
LOWER EOCENE BEDS - to 15 feet
WHITE CHALK - to 60 feet

Courtesy of "Natural History" and the author

TWO VIEWS IN A GRAVEL PIT IN EAST ANGLIA FROM THE DETRITUS BED MANY FLINT IMPLEMENTS CHIPPED BY PRE-GLACIAL MAN HAVE BEEN FOUND
Pliocene man lived, hunted and built his fires on the ancient land surface demarcated by the parallel ink lines near the center of the photograph Later, the land sank beneath the waters of the North Sea and received a deep deposit of sand and shells, which is now called "crag" Later it was re-elevated Mr Moir appears in the right hand picture, at the left side

Machining Mountainous Masses of Metal

The Story of an Organization Which Possesses Gigantic Machine Tools and a Well-trained Corps of Workers and Which Puts a Just Valuation on Men as Well as Machines

Photographs made in the plant of The Hooven, Owens-Rentschler Company, Hamilton, Ohio, by Scandlin

LOOKING AT THE FINAL CUT

This has been called by experts one of the finest industrial photographs ever made from an art angle. They have just finished the machining of the inside of a gas cylinder. The workman has crawled in for a last look before the cylinder is lifted from the boring mill

THE PHANTOM ARM OF SOLID STEEL

This tool is a draw shaper. The photograph was made as the tool was working, the large arm holding a cutter in its steel fingers and scraping a thick shaving of iron from the casting each time—a shaving that is measured to thousandths of an inch in thickness

THERE is something about the handling of large masses of metal, of transforming the visions of engineers into the huge engines and "fine realities of steel and iron," that fundamentally affects men and organizations. In the shop where the photographs on these two pages were made, are some of the biggest tools in the world. Big jobs are done as part of a day's work and size in itself loses its own significance.

For example, when the exigencies of war demanded marine engines, these men told the Shipping Board they could build 2,800-horsepower marine engines—though they had never had experience on marine work, and had never built an engine for a ship.

"How many can you build?" the Board asked.

"Two a week—indefinitely," said the clear-eyed engineer.

The impossibility of this was pointed out. They were asked to check and revise their figures. At the next meeting, in answer to the question, "How many?" they replied:

"We can build three 2,800-horsepower engines a week—indefinitely." And they did. It is of such stuff that industrial heroes are made.

Working to Gage Bred in the Bone

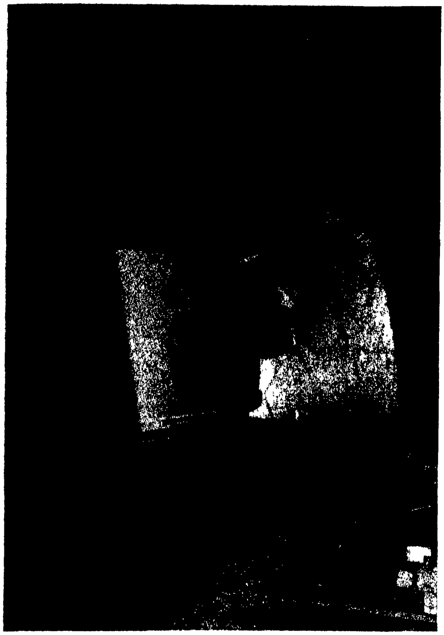
They received orders and actually built *four 2,800-horsepower marine engines a week* for many months. For the Emergency Fleet Corporation they completed ninety-one 2,800-horsepower, seventy-six 1,400-horsepower and twenty-five 750-horsepower marine steam engines. In five years their marine engine production jumped from zero until, in one year, they built more marine horsepower than any other engine builder or shipyard in the entire world.

That is one typical story of many that make the history of this shop. Another is the building of Henry Ford's 60,000-horsepower plant at Detroit. This plant is operated by means of a combination of gas and steam engines.

Their machinists are mostly sons of machinists whose fathers were machinists too. Working to gage is bred in the marrow of their bones. They learn instinctively, or are taught, to look beyond the job to the purpose. A man does not machine a shaft so much as he helps to build a sugar mill or a great engine.

Ask the man on the lathe what he is doing and he may tell you how vital the part is in the Diesel engine he is making. With this spirit from the top down and the bottom up meeting and fusing, the details of machine shop practice become of secondary importance.

Multiple machining made possible by big tools is one of their open secrets. Another is the quick scrapping of even good tools whenever a new tool is developed of sufficiently increased efficiency to justify the change. It is an upsetting, disturbing policy—but its value is certain. It permits a continual increase in production without the corresponding addition of floor space.



LIVING LIGHTS AND STRANGE SHADOWS

This huge boring mill towers as high as a house. We are looking at it from the rear. A workman has stopped for a moment to watch the tool at the working point—when the metal cuts metal as a steel plane shaves wood. This is a flywheel for a Corliss engine

A TOOL THAT CUTS BOTH WAYS

They are removing a gas cylinder from a horizontal boring mill. The mill machines two ways at once—at a perfect right angle. It is large enough to take a casting of any size. In this plant they made a single casting weighing 166,000 pounds

Some of the figures are significant. The crane equipment necessary to move the masses of material aggregates 543 tons capacity. One of their most interesting tools is a fifteen-foot planer equipped with four motor-driven heads. This planer is the heaviest and most powerful in the world. Among their thirteen huge boring mills are twenty-four-foot and twenty-foot ones. In the foundry, castings weighing from forty to fifty tons are made so frequently that they are just ordinary features of the day's work. A single casting they made for an engine bed weighed 166,000 pounds.

Naturally, where such large jobs are done, the timing of parts and processes, the routing through the shop, even inspection must be done on rigid schedules to avoid jams. Some tools run on tracks to facilitate quick work. Other tools are portable. They are lifted by the giant cranes and carried to the work. To give some idea of the variety and size of work done in this plant, here is a partial list of present production:

Forty-six plate glass tables, thirty-six feet in diameter, each weighing approximately one hundred tons. An 8,000,000-gallon steam-driven pump. A steel rolling mill order aggregating 4,000 tons consisting of eighteen-inch, forty-two-inch and thirty-two-inch rolling mills and tables. One 3,300-horsepower and two 1,500-horsepower Diesels. A twenty-one-roll sugar mill, the largest ever built, with a capacity of 4,000 tons a day. It will weigh about 2,000 tons. A number of simple and cross compound and tandem Corliss, Uniflow and Poppet Valve steam engines.

Great Variety of Production

This variety of production carries their products into practically every human business activity. The water you drink may be brought to you by an engine and pump built by this plant. The sugar you drop into your morning coffee may have been ground from the cane in a sugar mill driven by these great engines, all built in this plant.

Sculptors in Steel and Iron

When you come to New York and stop at a big hotel—the Pennsylvania, for example—a Hamilton engine down in the basement is running the generator that produces the electric light for your room.

The frame in your automobile may have been pressed by a gigantic Hamilton press (they make the biggest there are to be had) while the oil may have been transported by a tanker driven by these engines.

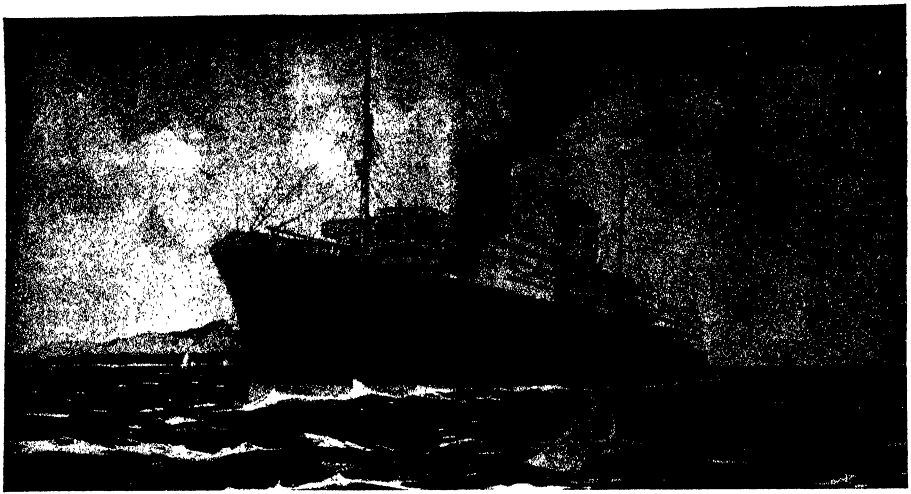
If you care to, you may visit this plant on a tour of inspection and see these giant engines in process of fabrication. The company makes no secret of their methods and welcomes visitors who come with a genuine interest in the work which they are doing.

But all the mechanical experts of the plant, their system of working, their service in every phase of industrialism on land or sea, seems little compared with the human element in the shops. They cultivate and cherish men much more than tools or systems. When the son of a machinist is old enough and ready for work, he is brought into the shop. Half the day he studies in a school—the other he learns to put into practice the theories taught him in the school. He is paid a salary from the start and when, after a definite time, he is "graduated" from the school, he takes his man's place at the bench or lathe, with the filled tool box he has earned as part of his course. It is easy to understand how this system would produce a personnel composed of men who have a genuine interest in and love for their work.

Some reference should be made to the camera studies made in this plant by Scandlin. We show but four. Most of them were made at night. There are many others, some of which have been pronounced by the experts to be the finest industrial "camera paintings" ever made.

In these pictures, something of the shop and the men in it, lives and grows. You feel the artist in the artisan—the creative spirit of these "sculptors in steel and iron" who seek beyond the beauty of form to the beauty of perfect usefulness.

And there is indeed truth and beauty in a running engine, a strange fascination in the to and fro motion of such mechanical perfection. This is only gained by shop technique of a high order.



THE "MALOLO" WILL BE THE FASTEST AND LARGEST LINER EVER BUILT IN THE UNITED STATES

The Largest American-Built Liner

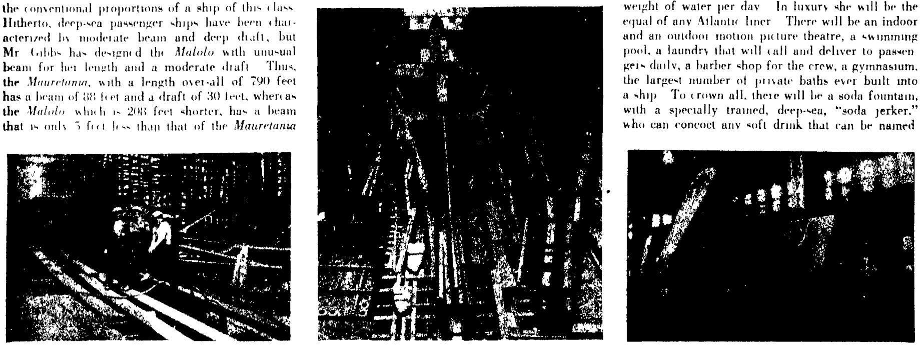
The "Malolo" Will Exceed in Size, and Speed Any Previous American Ship

THERE is now being constructed at Cramp's Ship Yard, Philadelphia, a passenger liner which, upon its completion in 1927, will surpass in size, speed and luxurious accommodation any American-built passenger liner

The *Malolo*, as she will be called, will have a length over-all of 582 feet, a beam of 83 feet and a displacement of 22,030 tons on a draft of 28 feet 6 inches. She is designed for a speed of 22 knots, with 25,000 horsepower. Her designer, Mr William Francis Gibbs, has made a striking departure from the conventional proportions of a ship of this class. Hitherto, deep-sea passenger ships have been characterized by moderate beam and deep draft, but Mr Gibbs has designed the *Malolo* with unusual beam for her length and a moderate draft Thus, the *Mauretania*, with a length over-all of 790 feet has a beam of 88 feet and a draft of 30 feet, whereas the *Malolo* which is 208 feet shorter, has a beam that is only 5 feet less than that of the *Mauretania* and her draft is $5\frac{1}{2}$ feet less, or only $21\frac{1}{2}$ feet

Steam will be furnished by a battery of 12 water-tube, oil burning boilers, which will carry a continuous working pressure of 280 pounds of steam per square inch This is in line with the present day tendency, which is toward higher boiler pressures In fact, so far as we know, this is the highest working pressure ever used on a passenger steamship The power is developed on two propellers, 19 feet in diameter, which will be driven by two sets of turbines, each with a high, intermediate and low pressure chamber The reduction gear will be of the mechanical type, with a ratio of 12 to 1, the turbines running at 1,500 revolutions per minute and the propellers at 125 revolutions The reduction gears, which are being built by the De Laval Steam Turbine Company, will consist of one main gear with one high-pressure and one low-pressure pinion mounted in the gear case.

The *Malolo*, which is being built for the American-Hawaiian Steamship Company, is well protected against disaster by means of double bottom and bulkhead protection, and a large pumping capacity sufficient for the ship to pump 146 times her own weight of water per day In luxury she will be the equal of any Atlantic liner There will be an indoor and an outdoor motion picture theatre, a swimming pool, a laundry that will call and deliver to passengers daily, a barber shop for the crew, a gymnasium, the largest number of private baths ever built into a ship To crown all, there will be a soda fountain, with a specially trained, deep-sea, "soda jerker," who can concoct any soft drink that can be named



DETAILS OF THE "MALOLO"

LEFT *U-shaped keel and vertical keel* CENTER *Building the double bottom Note the broad beam and fine lines of entrance.* **RIGHT:** ***The twenty-ton, steel, stern casing***

Courtesy of U S Bureau of Mines

THE EXPERIMENTAL GAS CHAMBER

While the subject is exposed to carbon monoxide, frequent tests of his blood are made

Courtesy of U S Bureau of Mines

GAS HEATERS A SOURCE OF POISONING

Apparatus to test effects of carbon monoxide escaping from defective natural-gas heaters

The Peril of Gas Poisoning

The Bureau of Mines Investigates the Poisonous Action of Carbon Monoxide

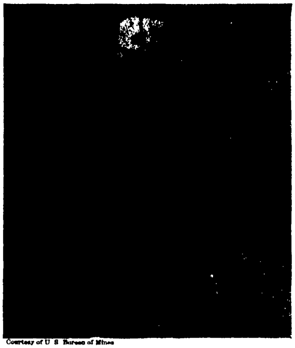
To a certain degree, the precautions which are recommended for use as a protection to the health of the community may be likened to a protective earthworks or stockade which is thrown up around the life both of the individual and of the community in which he lives. The hygienic laws which have been formulated during the last generation or two are among the most human and noblest achievements of contemporaneous civilization, for back of these laws lies a vast amount of patient, highly intelligent, very laborious and too-little-acknowledged work by bands of devoted men, whose rewards must consist chiefly in the satisfaction over a great work well done.

We have before us some reports sent out by the Bureau of Mines of investigations which they have made during the past few years on the important subject of poisoning by that insidious gas, carbon monoxide—a gas which is a product of incomplete combustion. The peril of the gas lies in the fact that it is without color, odor or taste, and, therefore, may exist in dangerous quantities without its presence being suspected.

Blood Samples Taken During Tests

It will be remembered that in making recommendations to the New York and New Jersey Tunnel Commissions, Dr. Henderson and his co-workers advised that, if the vehicular tunnel be so ventilated that persons passing through the tunnel would be exposed to not more than four parts of carbon monoxide in 10,000 parts of air, for not longer than 45 minutes, they would experience no ill effects. Supplementary experiments carried out by Messrs. Sayers, Meriwether and Yant, of the Bureau of Mines, at the experiment station at Pittsburgh, substantiated these findings. In this investigation, experiments were made in a gas chamber where the conditions could be accurately controlled, when the effects investigated were: (1) the effect of long exposure to low concentrations of carbon monoxide; (2) the effect during exposure of strenuous exercises; (3) the effect, lastly, of high temperature and humidity in low concentrations of carbon monoxide.

Exposure of blood to two parts of CO in 10,000 of air, as calculated by Henderson, may possibly produce 28.5 percent saturation of hemoglobin when equilibrium is reached; exposure to three parts in 10,000 is calculated to cause 37.4 percent saturation when equilibrium is reached, while four parts, according to his calculation, will produce 14.1 percent saturation. Henderson presupposes that the affinity of CO for hemoglobin is 300 times that of oxygen for hemoglobin. He further uses 15 percent as being the concentration of oxygen in the air of the lungs. He does not claim that the figures used are more than approximately correct but that they are sufficiently accurate to indicate what might take place. He also calls attention to the fact that many hours of exposure are required and that the time is really indeterminate before the circulating blood would come to equilibrium with the CO in the air.



Courtesy of U S Bureau of Mines

CARBON MONOXIDE SELF-RESCUER

This compact outfit provides the wearer, if caught in an emergency, with one half hour's supply of oxygen

The investigation at the Pittsburgh station took place in a specially constructed gas-tight chamber. The "work" was done on a bicycle ergometer and calculated as foot-pounds. In conducting the tests, examination was made of the body temperature, pulse, respiration and general condition of the subjects before they entered the chamber. During the test this was repeated, with the addition of the taking of blood samples to determine the rate of absorption of the carbon monoxide.

The ultimate conclusions of the test were:

1 The combination of CO (carbon monoxide) with hemoglobin takes place slowly when the subject is exposed to low concentrations and remains at rest, many hours being required before equilibrium is reached.

2 The rate of combination of CO with hemoglobin takes place much more rapidly during the first hour of exposure than during any succeeding hour, with the subject remaining at rest.

3 Strenuous exercise causes much more rapid combination of CO with hemoglobin than when the subject remains at rest. The symptoms of CO poisoning were emphasized by exercise while the subject was in the chamber.

4 High temperature and humidity, with a given concentration of CO, cause more rapid combination of CO with hemoglobin than do normal conditions of temperature and humidity.

All symptoms and effects described are called acute in character. None of the subjects has shown any permanent deleterious effects from the exposure to CO.

Gas Heaters Must Have Flues

The Bureau of Mines has also made a valuable contribution to our knowledge of the risk of carbon-monoxide poisoning due to the use of natural-gas heaters in the Pittsburgh district. In every case listed in the tests, none of the heaters was connected to a flue, its combustion products being liberated directly into the room. The Bureau found no fatalities from natural gas heaters, where a flue or a fireplace was provided.

The investigations of carbon-monoxide fatalities in that district are to be continued. The people at present are obliged to rely upon the honesty of the manufacturer and dealer as to the safety of heaters sold, and the report closes with the statement that "many of the heaters sold are recommended for use without flue connections; but to use them as recommended would be decidedly dangerous."

BARBER SURGEONS OPERATING ON PATIENTS

In the Sixteenth-Century operating room depicted in this old woodcut surgery amounted to brutality, and the barber was the surgeon Science had not yet found a better way

Price & Company

A MODERN OPERATING THEATER

Demonstrations on the diseases of the throat are being given to medical students Antiseptics, anesthetics and modern surgical skill add greatly to the patient's chances

The Progress of Medical Science—IV

Serums, Vaccines, Surgery, and the Outlook for Prolonging Life Through Hygiene

By Morris Fishbein, M.D.

Editor, Journal of the American Medical Association and of Hygeia

PASSING from drug therapy for a moment to the use of serums and vaccines, we come to a field that has been subjected to much abuse and exploitation, not so much by physicians as by the commercial purveyors of these products, who have by their wholesale advertising propaganda in many instances misled the physician. The untrained man, who was not familiar with the possibilities in this field, unfortunately has used such substances in instances in which they could not possibly have any effects, or in which their beneficial effects had not been demonstrated.

However, almost anyone who is able to study and evaluate scientific evidence would not hesitate for a moment to accept the evidence that diphtheria antitoxin has specific preventive and curative value in that disease, and that the serums for use in meningitis, tetanus or lock jaw, and cholera have adequate beneficial virtues. Almost anyone who can evaluate evidence would not hesitate to approve the use of anti-typhoid vaccination in the prevention of typhoid fever, or of vaccination for preventing smallpox and hydrophobia.

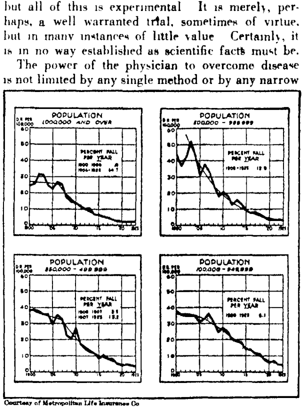
Some Gland Extracts are Failures

However, pneumonia, influenza, tuberculosis and many other complaints have not yet yielded completely to the attack of biologic preparations There is evidence that specific serums or vaccines may be of virtue in isolated instances, or if used in certain ways, but the evidence is not in any way comparable to the thoroughly established use of these products in the diseases that have been mentioned

Consider next the uses of preparations made from the glands within the human body. Of insulin, there is no longer any doubt The use of thyroid extract in cases in which the thyroid is insufficient produces results that are striking and to the uninformed actually marvellous

On the other hand, there remain a large number of conditions apparently due to deficiencies of glandular substances in which administration of extracts of the glands does not yield any satisfactory return Attempts have been made to overcome these deficiencies by the giving of mixtures of glands or of gland substances prepared in a special manner, but all of this is experimental It is merely, perhaps, a well warranted trial, sometimes of virtue, but in many instances of little value Certainly, it is in no way established as scientific facts must be.

The power of the physician to overcome disease is not limited by any single method or by any narrow conception of disease causation and pathology. He need not rely on drugs alone, or on biologic products alone. He may carefully apply methods for changing the entire metabolism within the body; by carefully regulating the diet, he may stimulate disposal of wastage. He may throw greater burdens on certain organs and diminish the burdens of others By increasing the blood supply to certain parts of the body through the use of heat, as applied by any one of several methods, for four or five minutes, he may stimulate that portion of the body to increased activity; by the use of cold, he may lower the rate of action in certain portions



Courtesy of Metropolitan Life Insurance Co

HOW TYPHOID FEVER HAS BEEN REDUCED

These falling curves offer a remarkable proof of the value of sanitation

He may avail himself of all of the effects of physical agencies, such as massage, light, water, exercise, diet, electricity and what not in producing improvement which has been known to follow the application of any one or all of these procedures.

Painless Surgery Is Quite Recent

The surgery of a century ago was a painful and almost brutal procedure With the coming of antisepsis and later of asepsis, following the work of Lister and Pasteur, the mortality which resulted from surgery was greatly reduced through the elimination of bacterial infection following operation.

With the development of anesthesia, beginning with the work of Morton and Long on ether, and following with chloroform, nitrous oxid-oxygen, gas, stovain and intraspinal anesthesia, the use of narcotics preliminary to operation to reduce the patient's sensibility and, more recently, the development of another gas anesthetic, ethylene, physicians have been able to work more slowly, more carefully and more accurately, extending surgical procedures to organs heretofore unapproachable by the surgeon's knife, thereby saving many lives in conditions previously called inoperable

Moreover, continued study of nerve routes and nerve paths, with the development of anesthetic substances which may be applied directly to nerves, permits effectively blocking the sense of pain which may proceed along the nerves to the brain. So-called local anesthesia with such drugs as procain and butyn enables surgeons to operate on patients who are fully conscious and therefore are better able to resist the shock which may accompany extensive operative measures.

Whereas operations were formerly limited to amputation, or to the hasty removal of such diseased tissues as an inflamed appendix or of a gangrenous

ovary, the modern surgeon enters the abdomen for the removal of masses of diseased tissue of great weight. He performs plastic operations within the abdomen, removing whole sections of the bowel, parts of the stomach and such organs as the kidney, spleen or gallbladder.

Studies of the physical mechanisms involved in breathing, with the construction of adequate pressure chambers, permit operation within the chest cavity, and quite recently investigators in Boston were able to introduce a tube directly into a beating heart and to cut one of the valves which had been so constricted by disease as to menace a child's life.

The brain, practically unapproachable in a previous century, is now the subject of operations for the removal of tumor, for the relief of abscess, and for other conditions which formerly meant certain death. Indeed, here diagnosis includes photography of the structure of the brain, accurate measurements of the pressure within the brain, and careful neurologic tests of sensation and function of parts far removed from the brain by which it is possible to localize, almost to a hair's breadth, growths within the brain before the skull is opened

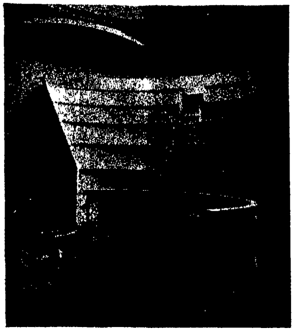
These marvels of scientific surgery are again not theory, but operations that have been performed and scientifically recorded.

Cancers Must Be Treated Early

As has already been mentioned, the attack on cancer through research as to its cause is beginning to build a narrowing hedge of facts which will sooner or later sift out the primary cause. But in the treatment of cancer medical science has gone even farther. Thousands of surgical operations on cancers diagnosed early in their course have yielded positive proof that complete removal at such a stage prevents recurrence and not only greatly prolongs life but may actually yield cure

In the attack on cancer the physical agents also have been called into play so that electricity in the form of diathermy and the cautery may be applied to advantage to kill cancer cells and to seal off the tissues which may be invaded, the apparently specific effects of high-voltage X rays may be applied to destroy cancer cells and to inhibit the growth of new cells, and radium in the form of the substance itself and of radium emanation may be used in certain instances to produce actual cures of cancer

The primary emphasis must be laid, however, on the fact that cancer must be seen and diagnosed early. After the tissues have been invaded and after the cancer has spread from the first point of origin to neighboring tissues and in some instances throughout the body, remedial attempts are usually hopeless.



AN OLD-TIME OPERATING AMPHITHEATER

The patient was strapped to the operating table No anesthetics existed Arrangements for preventing infection were crude

The death rate of tuberculosis has been reduced by more than one-half, typhoid fever no longer menaces communities which are willing to pay the price for good milk supply, good water supply and proper sewage disposal, inspection of fresh and prepared foods has practically abolished the menace of diseases formerly transmitted in this manner

Special attention given to the problems of infant mortality has reduced the death rate in the earlier years of life and an infant coming into the world today has a far greater expectancy of life than did one coming into the world fifty years ago The child that might then have expected to live to somewhere between thirty-five and thirty-nine years of age may now confidently look forward under all ordinary circumstances to reaching the age of fifty to fifty-five years. What hope, then, of giving that child an opportunity to reach its allotted three score and ten?

The diseases that still remain to cut down the human being at an age previous to the time when he might reasonably expect to depart this life through the actual wearing out of the machinery which is no longer able to renew itself, include at this time particularly the diseases of the heart, blood vessels and the kidney Such conditions as Bright's disease, a chronic inflammation of the kidney, as hypertension exemplified through high blood pressure and the symptoms that accompany it, as arteriosclerosis, or hardening of the arteries, as angina pectoris and inflammations of the lining of the heart and of its valves—all such conditions constitute a problem which the medical profession must meet and which it apparently cannot meet properly without the complete education and the intelligent cooperation of the public.

Here are diseases whose prevention seems to lie in the prevention of the infections of the throat in childhood, in the training of the child and man in the proper hygiene of the nose, throat and intestinal tract, in the teaching to the adolescent and equally to the adult of the desirability of a quiet, well-ordered existence with a proper amount of food, of exercise and of rest, and not the least by any means, in letting people know that there is such a thing as mental hygiene, including relief from worry or mental strain

Can We Keep Up Our Progress?

And then there is pneumonia, a disease likely to affect the older man much more severely than the young one, called, indeed, "the old man's friend" for the quick death that it produces in the senile, and the "captain of the men of death" for its severely fatal character The complete conquering of this infection seems somehow to be resting on the threshold of the future

It is the belief of several competent statisticians who have given careful consideration to the matter, that when these diseases are brought under control, the life expectancy will be moved forward at least another five years, but probably not a great deal more

The trend of modern life seems to be toward speeding up, toward greater mental strain and almost ceaseless activity If, coincident with such speeding, medical science is still able to promise another five years of life expectancy to the phenomenal numbers of years that have thus far been added, it will have accomplished a marvel beyond the dreams of the medical scientists of fifty years ago.

The progress of the last fifty years has been a pace maker which the centuries to come will find difficult to follow.

General Photographic Agency, London

OXYGEN ROOM IN A BRITISH HOSPITAL

In many diseases, notably pneumonia, patients find it difficult to breathe sufficiently to supply the oxygen need of the body. Therefore oxygen is artificlally supplied

General Photographic Agency, London

DEEP X-RAY THERAPY

X-ray apparatus with high voltage permits maximum penetration over short periods and is used for treating internal cancer This invaluable method is comparatively recent

A MACHINE FOR EXAMINING DETAILS OF SPEECH
The kymograph is used at the University College, London, to examine details of speech, peculiarities of dialect and to diagnose defective speech

AN APPARATUS CALLED THE "LIORETGRAPH"
This device is used to enlarge phonograph records. Some interesting discoveries made by the use of this instrument are described in the following article

Seeing Our Speech As Others Hear It

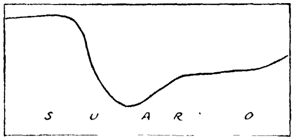
An Instrument Which Records the Various Attributes of the Human Voice

By Stephen Jones

Phonetic Laboratory, University of London, University College

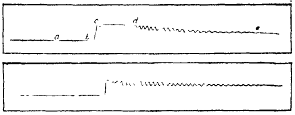
THE statement by Albert A. Hopkins in the Scientific American for February, 1925, that "among all the domesticated animals man is the one, it seems, about which we know least," possesses a deep significance. To this one is tempted to add the corollary—that what man is most ignorant of is his own manner of speaking. One is almost convinced of this when listening to speeches broadcast over the radio. It is certain that if speakers were confronted with their own deviations from what is considered good English, they would vigorously deny ever having uttered them. The following are but a few of the curiosities which have been noted from time to time:

A distinguished scientist, speaking about the structure of the atom discusses "the complex phenomenar inside it." While an English Cabinet Minister with an Oxford accent deprecates "the idear of fighting." A well-known singer assures us in his most convincing top-notes that "Sylviar is excelling," and a Shakespearian actor taking the part of Quince in *Midsummer Night's Dream* announces that he would "drawr a bill of properties." Further we are told by an official in a broadcasting station—presumably chosen for his good English—that he is "growingg old," while another relieves us of much anxiety by informing us that a certain well-known person is "on terra firmar again."



AN APPARENTLY HARMLESS WORD
FIGURE 3 *"Suaro" in the Indian vernacular means "troopers"*

The case of a person learning a new language is very interesting. He tends to hear what he is accustomed to hear, and consequently, he pronounces sounds in the new language as he would pronounce those of his own language which most resemble them. Certain foreigners, for instance, in speaking English, make no distinction between a "small bath," a "small bass," and a "small bus." In any English-speaking country, such a pronunciation could not but lead to disaster.



ANALYSING SPEECH BY THE KYMOGRAPH
FIGURE 1 (upper) *"Tea" as pronounced by an Englishman.*
FIGURE 2 (lower): *"Tea" as pronounced by a Frenchman*

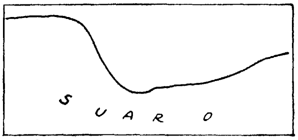
It is a strange but undeniable fact that the human mind is prone to postpone judgment when confronted by subjects of everyday occurrence. Generally, it never strikes one that these subjects merit consideration. They are taken as a matter of course, for, like the poor, are they not always with us? The very frequency of a familiar event dulls us to its importance. There is a curious elusiveness about familiar things. And what can be more familiar than speech?

Just as science corrects the defects of sight by lenses and deafness by acoustic devices so, by the aid of specially devised instruments, certain attributes of speech sounds which formerly escaped the ear can be brought into prominence and relief.

It is the purpose of this article to describe such an instrument, an instrument which serves to render the attributes of speech sounds, such as their duration, pitch, timbre and intensity, visible to the eye. That the eye is a help in the recognition of speech is known to many. How great that help may be is realized by few. The facility with which many deaf people are able to read lips is a remarkable example of how the eye may aid the ear.

Dr. Schuman, an authority on speech defects, goes so far as to say that the exercise of the function of speech on the whole frequently proceeds from its optical constituent. How important it is, therefore, that the visual representation of speech properties should not be overlooked or underestimated.

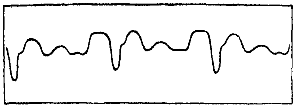
Instruments used for the visual representation of speech should be of great accuracy and delicacy, for important significance may be involved in some of the minutest details. How infinitesimal these details can be is shown by the following facts. It has been computed that during the act of speaking, pressure changes of less than a millionth of an atmosphere occur. Expressed in another way, this would be equivalent to the weight of a section of human hair one-thousandth of an inch long, that is, about one-third as long as it is broad. Cornet playing, we know, is a vigorous pastime. Yet, if ten million cornet players were to play *fortissimo*, they would only emit one horsepower of sound. How much less then must be the rate of expenditure of energy in speaking.



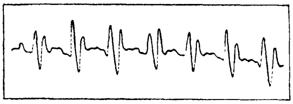
WRONG DICTION MAY MAKE TROUBLE
FIGURE 4 *"Suaro" mispronounced sounds like "Swine"*

The instrument shown in the top left-hand illustration on this page is called a "phonetic kymograph"—a name derived from two Greek words meaning "wave" and "writing." It was made by Mr. C. F. Palmer, Engineer (London) and consists essentially of two parts: (1) a surface to be recorded on and (2) sensitive recording points.

The surface is an endless band of glazed paper which is carried by one or two cylinders that rotate on parallel horizontal axes. On the paper is de-



GRAMOPHONE RECORD ENLARGED
FIGURE 5: *A note of a tuba magnified 350 times*



A LIORETGRAPH SPECIMEN
FIGURE 6: *The vowel "o" as in the word "born"*

posited, by means of a broad gas flame (impregnated with benzol), a thin layer of soot. The driving mechanism is an electric motor. The recording points are mounted side by side on a horizontal rod, which is furnished with a fine screw adjustment. This rod is clamped parallel to the axes of the cylinders. When the duration of a syllable or word is needed, a recording point, which is attached to a small electromagnet, is used. It records simultaneously with the other recording points. The electromagnet is actuated by an electrically driven tuning-fork, the frequency of which is a hundred complete vibrations per second. Intervals of time to less than the two-hundredth part of a second can in this way be estimated with ease. Other tracing points, which record vibrations issuing from the mouth, nose and larynx, can be employed. These tracing points consist of thin flexible strips of bamboo or celluloid. They are attached to the extremity of straw levers and give suitable magnification. The levers are supported in the centre of a sensitive vibrating membrane of thin rubber, or skin, which covers the bell-shaped elliptical aperture of a metal tube.

Duration an Elusive Speech Attribute

One of the most valuable uses of the kymograph is to aid one to decide the duration of speech sounds. There is no more elusive attribute of speech than duration. In music it is denoted by minims, crotchets, quavers, and so on. The name given to it by philologists, phoneticians, and writers on prosody is "quantity" or "length." A controversy about quantity was settled by recourse to a single experiment. The circumstance which led to the making of a record was as follows: There arose between Dr. Inge, Dean of St. Paul's Cathedral, London, and Dr. Robert Bridges, Poet Laureate, a discussion about the respective lengths of *a* in "cattle" and *a* in "cater." The Dean was invited to the phonetics laboratory at University College, London, to clinch the argument.

A glance at the tracings showed the equality in the vowel lengths of the so-called short and long *a's* in these words. Each *a* took eleven-hundredths of a second to pronounce, so that Dr. Inge's contention that the vowels were of equal length was fully established. Perhaps under the circumstances, it was but human that he should feel gratified.

Figure 1 shows a kymographic record of the word "tea" pronounced by an Englishman, while Figure 2 shows the same syllable pronounced by a Frenchman. The straight portion *ab* represents the closure of the mouth-cavity made by the tip of the tongue coming into contact with the teeth or the teeth ridge, *bc* represents the explosion made at the instant when the contact of the tongue is released. The wavy line shows that the air is being set in vibration by the vocal cords and therefore denotes voice. It will be readily seen that whereas in Figure 1 the voice starts operating immediately after the explosion, in Figure 2 it does not. The portion *cd* shows that the vocal chords are kept apart for a little time allowing a current of air to issue from the lungs. This phenomenon is called "aspiration" and is characteristic of these explosive sounds in English, German and the Scandinavian languages.

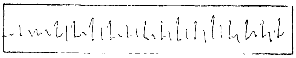
In the case of certain other languages matters would be very different. Some languages have both aspirated and unaspirated sounds of the *t* class, distinguishing one word from another, great confusion of meaning might arise if proper care were not exercised in putting in the aspiration where it should be present and leaving it out where it should be absent.

Valuable to the Study of Phonetics

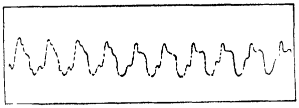
The importance of accurate attention to details of enunciation is amusingly illustrated in the following story, told by Lord Meston, one of the most distinguished of Indian administrators. It appears that a well-known general on one occasion decided to address his native troops on parade with a few words in the vernacular. His opening word was intended to mean "troopers", but, to the amazement of all who understood, the barrack square reverberated instead to a word which meant "swine!" By means of the kymograph the distinction is made clear, as Figures 3 and 4 show. They show the extent of the downward movement of the jaw with a simultaneous voice record beneath (observe the movement when the *r* is articulated). Figure 3 represents the word "suaro" (troopers).

Because of the delicacy with which the kymograph registers the details of speech, its great value in the investigation of certain nervous diseases will be obvious. The utterance of such nervous cases shows characteristic features and from these important diagnoses can be made. This use of the kymograph is, however, outside the scope of the work done in the phonetics department of University College, London, which concerns itself mainly with the analysis of languages.

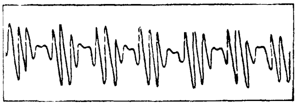
The importance of the phonetic kymograph in all researches into speech is becoming universally recognized. New languages for the purposes of commerce and human intercourse generally have to be analysed. These languages often possess unusual features which the unaided ear is unable at first to catch, with the result that the science of experimental phonetics is now accepted as not only useful but essential in linguistic studies. Moreover, with the universal popularity of radio, the spoken language is becoming more and more important, and pronunciation is tending to be considered synonymous with education and breeding. It is a significant fact that when writing "Pygmalion" and casting about for the most competent person to train a common cockney flower-girl to pass as a duchess, Bernard Shaw chose as her instructor a professor of phonetics.



SIR HARRY LAUDER'S VOICE
FIGURE 9: *Portion of a record of Sir Harry Lauder's voice as he sang "Oh, it's nice to get up in the morning." Magnified 150 times*



ANOTHER GRAMOPHONE RECORD
FIGURE 7: *A note of a cornet magnified 350 times*



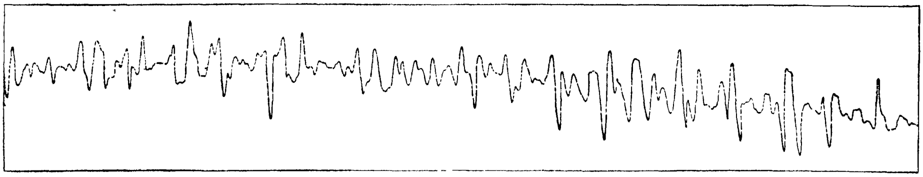
ENLARGEMENT OF THE VOWEL "A"
FIGURE 8: *The vowel "a" as in the French word "pate"*

To Analyze Phonograph Records

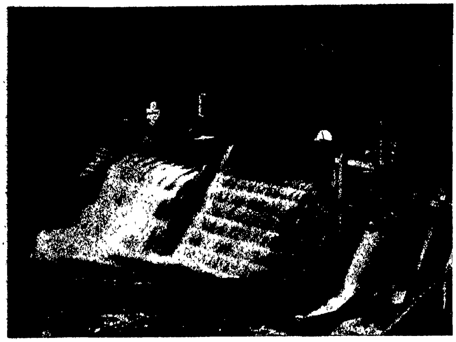
We now come to the second instrument shown on the opposite page. This machine was constructed for enlarging gramophone records. It is called the Lioretgraph from the name of its designer—Monsieur Henri Lioret of Paris. It is operated by turning the handle through a suitable arrangement of belts and pulleys. This causes the disc to rotate about a vertical axis as well as to travel horizontally, it also makes the drum (which has on it a band of smoked paper) rotate on the horizontal axis. All these movements occur simultaneously.

The process of enlarging is effected in the following manner. The gramophone needle is placed carefully in the groove of the record. As the handle is turned the needle follows the track of the record and the movements of the needle actuate a lever. Any motion is magnified twenty times. Means are provided for magnification from two hundred times upwards. The magnified tracings are recorded on a band of smoked paper on the drum.

By means of a small mirror movements can be registered by a spot of light on a sensitised film. Photographic records of enormous magnification are obtained in this way. The other figures are examples of the results obtained by the use of these instruments.



ANALYSING A PHONOGRAPH RECORD
FIGURE 10: *That portion of a record of the overture "William Tell" which describes the storm. Played by the Queen's Hall orchestra, conducted by Sir Henry Wood*



DETERMINING FORM OF DAM BY MODELS

Models to three scales to determine best method of controlling flow over crest of dam

OUTLET OF SHANDAKEN TUNNEL TO ESOPUS VALLEY

After flowing for 18 miles through the mountain range Schoharie water enters Esopus Creek

Running a River Through a Mountain

Gilboa Dam and Shandaken Tunnel the Crowning Achievement in the Water Supply of New York City

By J. Bernard Walker

AMONG the notable feats of civil engineering in America we do not hesitate to place the water supply of New York City in the very front rank. It may be said that the great works in the Catskill and Schoharie watersheds, in their complexity, in the difficult problems involved, and in the great variety of the work that was done, stand pre-eminent among the city supply systems of the world. Although the present article is concerned specifically with the new Schoharie water supply, including Gilboa Dam and the 18-mile Shandaken Tunnel, it will be in place at the outset to give a brief survey of the great struggle of the past 75 years to secure an adequate supply of pure drinking water to match the phenomenal growth of New York City.

Work Free from Political Interference

The first effort to provide not merely for the present but for the probable future needs of the city was the development of the Croton watershed, begun in 1837, by building a series of dams of very moderate size on the Croton River and its tributaries. This project included an aqueduct from the reservoirs to New York, which is still in service. On its completion the city fathers believed that they had secured sufficient water for an indefinite period, but before many decades had passed, the ever growing city was threatened with a possible water famine, and it was determined in 1892 to build a lofty dam on the Croton, not far from the Hudson River, and create a reservoir which should overtop the old Croton Dam and extend for some 20 miles up the valley. This great dam, some 300 feet in height from foundation to crest, attracted world-wide attention. It impounded 34 billion gallons of water, which was led through a larger aqueduct, aided by the old aqueduct, for some 31 miles, to the reservoir of the old system in Central Park. The above development is shown in the accompanying birdseye view on the easterly side of the Hudson River.

This great work was scarcely completed before Greater New York began once more to be anxious for the future, and as a preliminary to developing the waters of the Catskill Mountain region, there was appointed a Commission known as the Board of Water Supply which was to have full responsibility for the work. Most fortunately, this board was so constituted that it is free from political interference and its financial requirements are not hampered by any consideration of the city debt limit, since the water-supply systems of the city are on a self-supporting basis.

NEW YORK WATER SUPPLY AT A GLANCE

Birdseye view showing Gilboa, Ashokan and Croton reservoirs and the 120-mile aqueduct to New York City

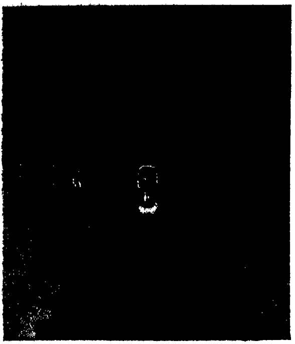
The first development was that of the watershed of the Esopus stream which, with its tributaries, heads in the higher ranges of the Catskill Mountains. To this end was built the great Olive Bridge Dam across Esopus Creek, which consists of a main masonry structure, 252 feet from the lowest foundations to the crest, which, with the earthen dikes which close the gaps between the hills, has a total length of 5½ miles and serves to impound 128 billion gallons of water.

In addition to the Ashokan Dam there was built the Kensico Reservoir, in Westchester County, thirty miles north of City Hall, which was designed to provide sufficient Catskill water to supply New York over a period of several months. It is an emergency reservoir to serve the city should the aqueduct between Kensico and Ashokan be at any time out of service. This dam has a maximum height, from foundation to crest, of 307 feet; and the reservoir has a total available capacity of 29 billion gallons.

Eighteen-mile Tunnel Beneath City

Fifteen miles south of Kensico and just to the north of the New York City line, on the highest ground available in the city of Yonkers, is an uncovered artificial reservoir, contained by an earth embankment and lined with concrete, which has a depth of 36½ feet and holds 900 million gallons of water. Its function is to equalize the difference between the use of water in the city and the steady flow in the aqueduct.

The building of these extensive works by no means covered the whole of the problem; for this vast supply of water had to be got down to New York City. To this end a large aqueduct was constructed from Ashokan Dam to Staten Island, a distance of 120 miles. It varies from a horseshoe cross section 17 feet 6 inches by 17 feet to a circular diameter of from 16 feet 7 inches to 11 feet. The work was constructed entirely below ground, out of sight, and therefore protected from any possible contamination.



SHANDAKEN TUNNEL

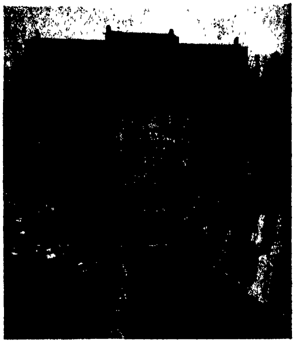
This great conduit, 18.1 miles long, was blasted through the mountain and finished off with a heavy concrete lining

Most remarkable of all are the syphon 1,200 feet below the Hudson and the tunnel beneath New York City. How many of its citizens realize that from Hill View Reservoir, just beyond the city line, a circular tunnel from 15 feet to 11 feet in internal diameter, has been driven in the solid rock for a distance of 18 miles, or nearly to the end of Manhattan Island, and thence under the East River to Brooklyn. Hundreds of feet below the roar and bustle of the city is this great artificial conduit, whose supply of pure mountain water is tapped at various places through vertical shafts extending to the surface.

The latest of these works for bringing pure mountain water into the city, if not the greatest in magnitude is certainly the most appealing in regard to its novelty and daring. In looking for some new area among the many watersheds of the Catskill Mountains, a most extensive survey was made both of the streams which flow into the Hudson River and of those which flow in a general northerly direction into the Mohawk River. Of the latter, the most promising was Schoharie Creek, but between the great Ashokan Dam which impounds the Esopus Creek and the Schoharie Creek there lies one of the loftiest ranges of the Catskill Mountains. And if a reservoir were formed by a dam across Schoharie, how would it be possible to bring this water to New York City? It could not be pumped over the mountains, for the cost would be prohibitive. So the engineers of the Water Commission decided upon a bold and unprecedented step. The flow line, or surface level of the water, of the Gilboa Dam is 1,130 feet above sea level, whereas the flow line of Ashokan is 590 feet above sea level. The bold step was taken of driving a tunnel entirely through the intervening range of mountains for a distance of 18.1 miles, and thereby passing the water into Esopus Creek down which it flows to the Ashokan Dam.

Gilboa Dam and Tunnel

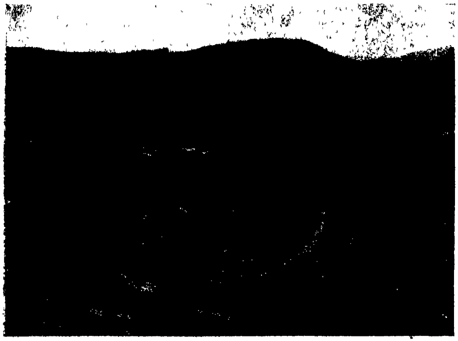
The Gilboa Dam, which is practically completed, consists of two parts, a masonry portion which is 1,300 feet in length, with a maximum height of 182 feet and a width of 158 feet at the base, and an earth section with a core-wall, which is about 700 feet long. The surplus waters in time of flood will be spilled over the top of the masonry dam; and at the toe of the dam there has been built a wide spillway which will receive these waters and pass them down into the Schoharie River bed. The upstream face of the dam is approximately vertical; but the downstream face has been formed in a series of eight steps, most of which are 20 feet in depth. The object of this was to let the enormous amount of storm waters, which at times will pass over the crest with a depth of five feet, down to the foot of the dam in a series of cascades, so as to diminish the force of the impact when they reach the bottom. If this water fell over in a continuous cascade, its energy would be sufficient to disintegrate the rock at the toe of the dam and endanger its stability. Mr. Thaddeus Merriman, chief engineer of the Board of Water Supply, with a view to breaking up the initial rush of the waters at the crest, is building on the crest a series of diagonal masonry vanes, which will cause the water to leave the edge of the dam in diagonal and opposed directions, thereby absorbing some of its energy and facilitating its passing in cascades down the 160 feet of fall. The masonry section of the dam is founded on solid rock. It was built of cyclopean masonry, consisting of very large blocks of stone buried in concrete. A 700 foot earth section was necessitated at the west bank because of an old and very deep underlying pre-glacial gorge. The core wall of the earth embankment, which is continuous with the masonry section, extends through the earth section and is carried deep into the hillsides and also a hundred feet below the natural bed of the valley, so as to intercept any underground water flow. The reservoir formed by the dam will extend nearly six miles up the valley and will provide an available supply of 20 billion gallons of water



ENTRANCE TO THE TUNNEL

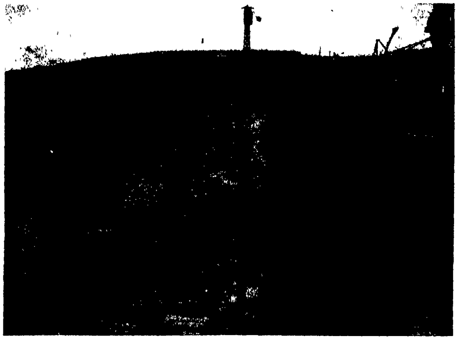
Above is the Gate House and below are the bronze locks through which Schoharie enters the Shandaken Tunnel

The Shandaken Tunnel is longer by 1,787 feet than the above mentioned tunnel below Manhattan Island, which hitherto was the longest tunnel in the world. The northerly 3½ miles of the tunnel is depressed, making that portion a pressure tunnel; but along the rest of the distance there is a uniform slope of 4.4 feet to the mile toward the Esopus Valley. At the intake is a fine masonry building for housing the controls of the gates, which is shown in one of our illustrations The water enters the tunnel through bronze gratings, and after its journey of over 18 miles, it issues from the side of the mountain into an open masonry-lined cut, through which it is led to Esopus Creek To anyone who has been favored with a reasonable amount of sentiment and imagination, the sight of this river of crystal-clear water streaming forth from the base of the mountain is appealing. The total cost of the entire Catskill Mountain Water Supply System is $188,000,000.



GENERAL VIEW OF GILBOA DAM

This shows the masonry dam, 1,300 feet long, and in the foreground the earth dam section



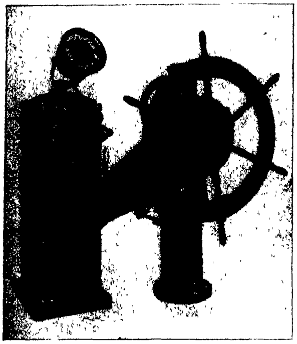
DOWNSTREAM VIEW OF GILBOA DAM

The downstream face is stepped to break the force of the overflow into the spillway below

The Automatic Quartermaster

The Gyroscope Automatically Guides the Ship, the Steersman Standing By

HAVE you ever heard of "Metal Mike?" He is a little iron man, who has invaded that nautical holy of holies, the pilot house, the home of the quartermaster, and taken his place And the remarkable thing about this usurpation is that no one resents it, in fact, the quartermaster, who by all the rights of the case should be most disgruntled, is Metal Mike's best friend and greatest admirer.



THE SPERRY GYRO PILOT

At left is a repeater compass, which through contacts operates a motor in the case below This motor, through a chain drive, operates the steering wheel at right

Now Metal Mike is a seaman's nickname for one of the most ingenious and successful nautical devices ever designed since the first savage shaped a tree trunk into a canoe or flaked a stone for the head of his tomahawk.

Every one of us, doubtless, possessed at one time in his boyhood that curious little toy called the gyroscope, whose fantastic performances caused our eyes to open wide with all the incredible wonder of youth "Just a toy," people called it in those days—yet today it is one of those boyhood toys that has laid its hand upon the steering wheel of the *Leviathan* and guides that mighty ship, unerringly, day and night, upon its course. The Sperry Gyro-Pilot is compass and quartermaster rolled into one In the most literal sense, it has displaced the hand of the human pilot, as shown in the accompanying illustration. Once the course is set, the captain, first officer, seaman—either of them merely "stands by"; that little toy of your boyhood does the rest, and steers a straighter course than the most skilled quartermaster can accomplish. If you doubt it, look at the comparative record of hand steering and gyro steering as shown at the bottom of this page and note the even course steered by the gyro-pilot.

The gyro compass has taken the place of the magnetic compass because it is free from the defects of the latter The magnetic compass does not point to the true north. In some locations it points to the east of north, in other places to the west of north. This is known as the variation of the compass. Its amount must be known at any given place, and an east or west correction applied before the navigator can determine the true north and lay his course with accuracy.

Always Points to True North

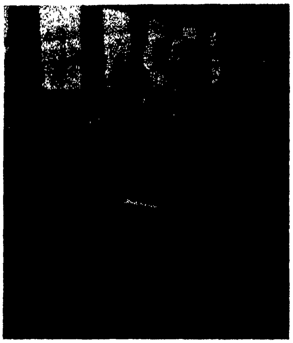
Now the gyro compass is subject to no such variation. Once it is adjusted to true north, to true north it will point throughout the voyage. This is due to the action of a law of motion which says: "Every body continues in its state of rest or of uniform motion in a straight line, unless it is compelled by forces to change that state." If a gyro, set in gimbals so as to have perfect freedom of angular movement, be set spinning at the equator, with its axis horizontal, its axis, as the gyro is carried round by the rotation of the earth, will not change its position with regard to space, but it will change its position with regard to the earth By the time the earth has rotated through ninety degrees, the axis of the gyroscope will be perpendicular to the horizontal, and so it will appear to rotate (contra-clockwise) throughout the twenty-four hours of a complete rotation of the earth

This action of the spinning gyro is shown in the right-hand diagram at the bottom of this page It takes place in accordance with the law of motion above quoted and is known as "fixity of plane."

Another characteristic of the gyro is "precession" If you apply pressure to the frame of a spinning gyro, tending to tilt it in a certain direction, the axis of the gyro wheel will tilt, not in the direction of the pressure but at right angles to it—in other words, the gyro will precess. The phenomenon of precession is utilized in the gyro-pilot to secure constant north indication.

A U-tube, partially filled with mercury, is mounted perpendicularly to the plane of the gyro wheel and rigidly connected to the bottom of the gyro case. The flow of mercury to the low side of the tube as the earth rotates furnishes just the amount of force about the horizontal axis of the gyro wheel to make it precess to the meridian and continue to point exactly and all the time and at any and every spot on the face of the earth to true north.

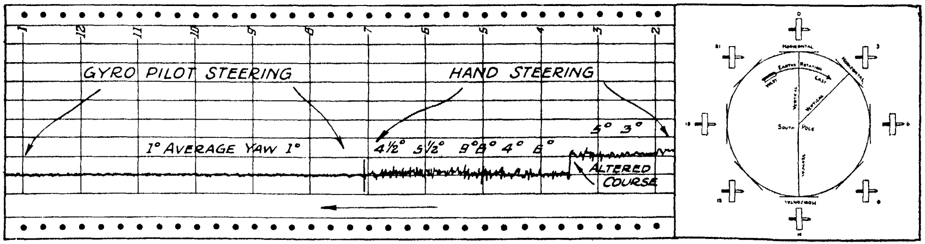
The master compass contains a gyro wheel weighing 55 pounds, which is driven by an electric motor at 6,000 revolutions per minute. Repeater compasses may be placed throughout the ship. The compass, moreover, automatically records the ship's course and time on a strip of paper for the information of the officer in charge of the bridge



INSIDE A LINER'S PILOT HOUSE

Here we see the gyro-pilot, or automatic quartermaster, coupled up and steering the ship The quartermaster is no longer required, except to stand by in case of accident

The latest feat of the inventor, Mr Sperry, after whom this compass is called, was to arrange for the compass automatically to steer the ship. This it does through a contact-maker operating a motor on the steering column A chain drive leads from the motor shaft to the ship's steering wheel alongside We invite a study of the strip at the bottom of this page showing the improvement in the ship's course when the change was made from hand to gyro steering.



THE EVEN COURSE OF GYRO PILOT STEERING

LEFT. *The line in the left hand portion of the diagram was automatically drawn by the compass itself. At the right, the jagged line shows the inequalities of hand steering* RIGHT: *The gyro maintains the same plane with regard to space, but changes its plane with regard to the earth*

From the Oldest City in the World

The Ruins of Ur, Traditional Birthplace of Abraham, Yield New Art Treasures

Photographs by courtesy of the British Museum, London, through the Illustrated London News

THE eleventh chapter of Genesis tells us how Abraham and his kindred left their ancestral home in "Ur of the Chaldees" for a journey which was to end in the land of Canaan. For over two thousand years that was all that the world remembered of the once great city of Ur, possibly the first great city to be built in the world.

Such Babylonian histories and traditions as had come down to modern times through the great Greek historian Herodotus or the ancient Babylonian priest Berosus, did not mention Ur. The "Chaldeans" were remembered through references to their remarkable knowledge of "magic," by which was meant, of course, the science of ancient times. But their city was forgotten except for that one brief mention in the story of Abraham.

One of the copper bulls from the remarkable relief found at Tell el Obeid, near the site of ancient Ur. The head was cast, the body hammered out of thin copper plates and attached to the head with nails

About a half century ago it was rediscovered. A huge mound of dirt, rain-washed and featureless, was known to be standing in the desert just west of the channel of the Euphrates River and about one hundred miles up stream from the present shore of the Persian Gulf. Some bricks inscribed with the curious wedge-shaped writing of ancient Babylonia were found near this mound. When these inscriptions were translated they proved that the great mound and some smaller ones surrounding it are all that is left of the city where Abraham was born.

Little work was done on this mound until after the World War. The conquest of Babylonia by the British armies then opened up the country for archeologists. During the past three years Major C. L. Woolley, commanding a joint expedition of the British Museum and the Museum of the University of Pennsylvania, has been making extensive excavations in the mounds that mark the ancient city.

Not only has Major Woolley discovered great temples and other buildings which belonged approximately to the time of Abraham, some four thousand years ago, but he has carried the history of the city many centuries farther back. When Abraham was a boy in the house of his kinsmen of Ur thirty-five or forty centuries ago, the city was already more than two thousand years old. It had already been a great seat of civilization and commerce for a period much longer than the time from the birth of Christ to the present day.

The oldest written inscription ever found in the world turned up not far from Ur, at a place now called Tell el Obeid, probably one of the suburbs of ancient Ur. This inscription had been placed originally in the foundations of a temple, just as we still place boxes containing newspapers and other mementos in the cornerstones of modern buildings. The inscription is carved on a small tablet of stone in the curious picture writing which was then in use at Ur. Scholars of the University of Pennsylvania have translated it. It says that King A-an-ni-pad-da, who ruled Ur in those days, dedicated that temple to the Goddess Nin-har-sag. It was written, the experts believe, about the year 4500 B.C., more than sixty-four centuries ago

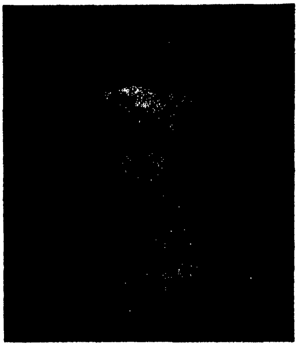
The excavations have yielded, also, many remarkable art objects, some of which are illustrated on this page. The walls and courts of the great temple of Nin-har-sag, as well as of other public buildings, were decorated with painted or sculptured scenes.

Among the treasures found at Ur is a wonderful relief showing a procession of bulls and made out of cast and hammered copper. Other objects are made of bits of white shell inlaid on a ground of black bitumen. This bitumen is our modern "crude oil" or asphalt. It was collected at the oil springs and seepages which still exist in Babylonia. It served the masons of Ur as mortar and the artists of the time as a cement to stick their reliefs and carved plaques to the walls.

The people who founded Ur were the famous Sumerians, a people who must have been one of the ablest and greatest of all history, but who were totally forgotten until modern scholars began to dig up and read the records which had been buried for so many centuries in the ruins of the Babylonian cities. No one knows for certain where the Sumerians came from. The most plausible theory is that they came from India; possibly by overland migration but more probably in small boats along the shore of the Indian Ocean and the Persian Gulf.

These birds were carved out of white limestone and were probably attached, with staples, to the frieze which originally decorated the temple wall. They were found in the ruins of the temple of Nin-har-sag, at Tell el Obeid

Some time in the millennium between 5000 B.C and 4000 B.C., these Sumerian immigrants arrived in what is now Babylonia. The country was inhabited then by rude tribes who eked out an uncertain existence on the low and tiny islands scattered among the marshes at the head of the Gulf. The Sumerians introduced civilization. They already knew how to write and make records. They possessed tools of copper. They wore clothes. Presumably they had tamed some animals, including a variety of buffalo. They had kings and wise men (who were also priests) and some ideas of religion



This statuette, also found at Ur, is of much later date than the other objects pictured on this page. It is believed to belong to a time when Ur was under the rule of kings of other cities, about 2800 B. C.

By 4500 B.C., possibly by two or three centuries earlier, there were at least five great cities in the lowlands near the Euphrates River. One of these was Ur. The head of the Gulf was farther north then than now, and Ur was on the seacoast. Silt deposited by the two rivers is responsible for the hundred miles of land that now separate its site from the shore. Another great city was Eridu, a few miles further down the shore from Ur. Farther east, also near the then coast line, was another city named Lagash. Up the Euphrates some thirty miles was Erech and on an arm of the river was the fifth city, Larsa. These five made up the earliest Sumerian state, the first civilized country in the world.

In the twenty-five centuries that elapsed from those days to the time of Abraham, Sumeria suffered many vicissitudes. Kings and dynasties came and went. A semitic people from the hill country to the north and west came down and conquered the five cities. They absorbed the writing, the arts, the civilization of their victims. Wealth and prosperity grew. Other cities were founded, including the great Babylon, a hundred miles farther up the Euphrates. Finally, in Abraham's time, the twenty or more cities then existing on the Babylonian plains had become the commercial and artistic centers of the world.

This bull, also from the frieze in the temple of Nin-har-sag at Tell el Obeid, was carved in white shell, probably taken from the Persian Gulf

Brown Brothers

Wintering Habits of Insects

By S. F. Aaron

Drawings by the Author

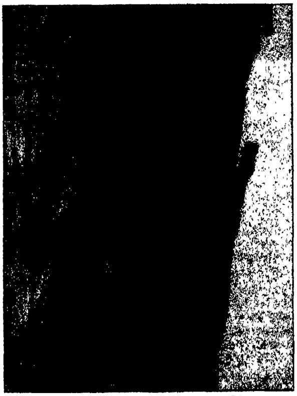
ALTHOUGH summer time and hot weather is the season wherein the entomologist can find the most abundant opportunity for investigation of the habits and the struggle for existence among the insect hosts, there are also during the other seasons—even in the winter—periods permitting of and inviting delightful inquiry.

An understanding of the general aspect of this subject must include the knowledge that suspended animation is the rule among nearly all so-called cold-blooded animals, whether having indoskeletons or exoskeletons, (vertebrates or invertebrates as commonly understood). Despite the asseverations of would-be interpreters of nature that cold destroys all life, or at least all life not especially protected, it must be here insisted upon that among all of the lower animal forms, cold in itself destroys no life that still has its normal functions to perform, although it may somewhat hasten death.

Shelter from Enemies Important

Thus, ants, butterflies, bees live their lives within a few weeks' time and, suddenly becoming decrepit, die in any season Cold or excessive dampness hastens this demise But if the creature's natural functions in propagating its species have not been performed, if it still has to mate and lay its eggs, it will not die under normal conditions of cold, no matter how severe. The crushing effects of ice may prove fatal, hence the hereditary instinct of insects to seek places of shelter for the placing of fragile eggs and cocoons, the hiding away of adults or pupae in dry crannies and crevices Even more important than shelter from the weather is that from enemies the close-gleaning winter birds, the mice, shrews and squirrels and certain larger quadrupeds, as the skunk, opossum, raccoon and even the bear.

Many insects and others of the Arthropods commonly pass the winter in the egg stage, these are the *Orthoptera* generally, (grasshoppers, crickets, wood roaches, walking-sticks and mantis), most of the true bugs *(Hemiptera)* and the spring-tails *(Thysanura)*—all insects with active pupae. Spiders, pedipalpi (daddylonglegs), and the millipeds survive the season of cold both as eggs and as young, protected by webs and by hiding.



HOW BLACK ANTS HIBERNATE

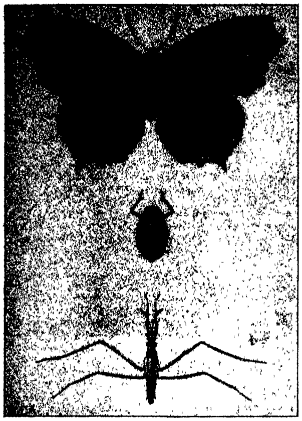
These insects winter in old beetle borings which they often enlarge for nests. If the long tongues of woodpeckers do not reach them, many will survive the cold. Wood split to disclose borings

Most other insects that go through imperfect metamorphoses, such as the several varied waterflies *(Neuroptera* and *Perla)*, the dragonflies *(Odonata)*, and the caddisflies *(Trycoptera)*, pass their transformations in the water and mostly winter as larvae and pupae, although sometimes as eggs attached to water grass or under stones, sticks and leaves in shallow places either stagnant or moving. Other allied forms, such as the ant lion, *panorpa* and *mantispa*, lay their eggs in loose earth where, if laid late in the season, they remain to be hatched by the spring sun, or, if earlier, the larvae remain in the same spots. Allied barkflies *(Psocidae)*, protect their eggs by webs or by depositing them in the tiniest chinks and cracks.

Some Migrate to Warmer Climes

Those insects with inactive pupae and that pass through, therefore, complete metamorphoses, such as the butterflies and moths *(Lepidoptera)*, the bees and wasps *(Hymenoptera)*, the beetles *(Coleoptera)*, and the two-winged flies *(Diptera)*, almost invariably survive the winter in the pupae or chrysalis form, or as adults, far more rarely as eggs or larvae. Any instance of the latter may be explained by the fact that the adults are hatched late and consequently that they are late in laying their eggs. We may observe certain butterflies, as, for example, the common sulphur yellow *(Colias)*, and the small yellow-spotted black swallowtail *(Asterias)*, ovipositing, the one on clover, the other on wild carrot, as late as October. These eggs hatch in spring; if hatched a little earlier the caterpillars may in a few cases survive the winter. All pupae withstand the cold; many revive early.

We see also black hornets, yellow-jackets and paper-nest wasps working as late as early October, seeking food and supplying their young. The larvae and even some late eggs are almost always sacrificed



INSECTS THAT HIBERNATE AS ADULTS

The mourning cloak butterfly. A water beetle—the gyrating apple bug. A common water strider

to birds or shrews and some to fungous diseases. All of these species usually winter as adults, deserting their nests for narrow spaces and close pockets under loosened bark and for rock crannies where the larger number of them are found and eaten, despite their easily revived stings. Longfellow's well-known line might be most truthfully altered to read: "There are no hornets in last year's nest."

Bumblebees remain in their nests. These nests are generally well protected and warm from numbers, but many die from fungous diseases. Those that live seem to be mostly queens, some of which continue the same colony efforts in the spring, along with a few surviving workers.

There are a few species of all orders that winter as adults and even those that do are rarely in large numbers. Ants and honey-bees are an exception. Many flies perish, some *Tachinids* seek the paper nests of hornets deserted by the makers, or get into bark crannies and among piles of leaves where the winter birds find most of them. Mosquitoes and other gnats seek rock caverns, hollow logs and trees and man-made cellars where they often winter in considerable numbers.

Among the butterflies, the cosmopolitan mourning-cloak *(Vanessa antiopa)*, the angle-wings *(Grapta)*, and occasionally a Hunter's butterfly *(Pyramens)*, winter as adults. Some of the angle-wings and other species even migrate to more charitable climes to put in the winter and choose their places of hiding with the utmost care, wedging themselves into crannies hardly wider than will admit their folded wings.

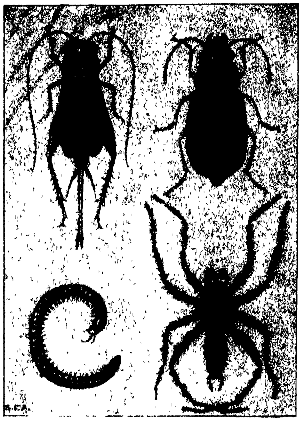
All Easily Revived by Warmth

Certain moths also may be found hibernating in dense clumps of grass and these are invariably seen early in the spring flying about thicketed fields. Moreover, as is the case with the butterflies above mentioned and especially the antiopa, sunshiny winter days often bring them forth and with wasps and bumblebees they may be seen flying about even over patches of thawing snow, while gnats and midges dance in the weak sunshine.

Certain beetles also, as the black ground hunters *(Harpalus)*, and members of the *Staphylinidae* pass the winter as adults, on mild days the dense leaf carpets under the snow may be scraped away and these little fellows may be seen scurrying away from the disturbance. The common brown elater beetle is another species that seeks flimsy winter quarters and is easily revived. Aquatic species winter in silt and among water grass roots.

A few of the insects that commonly experience a tragic ending of their days and a lack of resistance to enemies, with the coming of the enervating frost, sometimes successfully evade the hungry insectivorous hosts and may reappear in the early spring.

Some common short-horned grasshopper also awakes from deep sleep within the tangled stalks of a grass tuft where it has by chance escaped the shrews and mice. And the giant dragonfly *(Aeschna)*, is among the first to skim about in the earliest days of spring. Its transformations within the ponds are too slow to permit of its sudden appearance this early, the adult specimens must have survived the cold, but where they hide is a mystery. Gnats and other slender-bodied creatures can creep in anywhere, but the normal habit of these large dragonflies—their bodies and the expanse of their rarely folded wings exceeding four inches—is to hang openly on an outer leaf branch where, when rendered comatose by the cold, they would be a ready tidbit for the birds.



FOUND UNDER STONES, LOGS AND ROOTS

Female of the common cricket. A yellow-legged black ground beetle. A millepede. A funnel web spider

To be more fully satisfied with regard to suspended animation—although the instances in nature are sufficiently conclusive—I have subjected many live insects, taken into the warmth during the autumn, to the most severe cold, often artificially induced. These specimens were exposed out of doors with the temperature at zero, encased in salted snow and ice, and frozen for many days. Some were placed in water so as to be enclosed by the forming ice. All these tests seemed to be convincing. In every case the majority of the specimens revived quickly—butterflies, moths, wasps, dragonflies, grasshoppers, roaches, beetles and colonies of bees and ants. Among the latter about two-thirds of the number revived, the others had reached their natural span of life.

A GIANT DRAGONFLY'S MANNER OF PERCHING

It is a mystery how these insects escape their winter enemies. How and where do they hide?

RED LEGGED GRASSHOPPER HIDING FOR THE WINTER

Here, within a grass clump, the winter birds, shrews or mice may find and eat it

Specially photographed for the Scientific American by Brown Brothers

GENERAL ASSEMBLY

The bells are hung on a rigid framework, thus permitting a close adjustment of the clappers

Specially photographed for the Scientific American by Brown Brothers

RINGING MECHANISM

A recoil spring insures tension and balance throughout the operating leverage

The Music of the Skies

How Bells, Which Had Their Origin in China Thousands of Years Ago, Have Been Developed Into Carillons and Have Been Brought to America

By Henry B. Curry

AMERICA is now enjoying the music of the largest and best of all the carillons. But what is a carillon? The carillon, still unfamiliar to many Americans, is similar to the bell chime, but far superior. It is the most lasting yet the rarest, the loudest yet the most ethereal, among artistic instruments.

Often we confuse the carillon with the chime. A set of chimes usually includes eight to ten bells, all fairly large, ranging in weight from 300 to 6,000 pounds. A chime is attuned only to the diatonic scale, that is, the white keys of a piano. Its range is very limited, although six bells suffice for playing "Lead, Kindly Light," and eight are enough for a hundred tunes. A first-class carillon will comprise from thirty to forty or more bells, great bass *kolokols*, to use the sounding Russian word, that may weigh 16,000 pounds, and little, silvery tinklers of twenty pounds or less. The range will be three or four chromatic octaves, including all the sharps and flats of the scale.

Real carillons are divided distinctly into two classes: mechanical instruments, wherein the bells are sounded through connections with an automatic revolving drum, after the fashion of a music box; and the far more artistic carillon, operated through a keyboard—more properly a handle-and-pedal-board—which is played, like that of an organ, by hand and foot.

Brown Brothers

TOWER OF THE ANTWERP CATHEDRAL

Here the Hemony bells, the most famous of all carillons, are rung by the "master" bell ringer, Gust Brees, father and teacher of Anton Brees

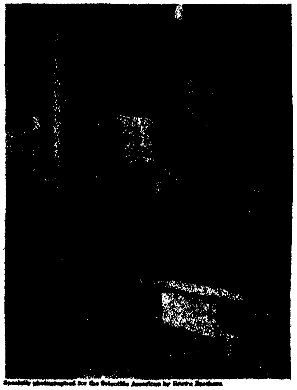
Tuned as Accurately as a Piano

The invention of bells is claimed for China. Their association with pagan rites of old Greece and Rome, deferred their use in Christian shrines for many years. By the Ninth Century men with hammers were striking rude chimes in churches, and by the Sixteenth Century, when groups of Belgian bells were sounded first as adjuncts to town clocks, the carillon was started. The name itself has been connected with the "quadrillionen," or four diatonic bells, that composed a mediaeval chime.

From this beginning the carillon spread rapidly throughout Belgium and Holland and, to some extent, into Germany and Northern France. But for reasons that psychologists may discover its growth has been restricted. Carillon playing has been specially identified as a Flemish art, and has been accepted as "one of the finest cultural products of the Low Countries."

At present nearly every city and town in the "Nether" countries has its bells and its official bell-master or "carillonneur," whose standing is that of the organist in any important American church. About 100 carillons were recently listed in Belgium and, in Holland, 115. Nine of the Belgian carillons were destroyed during the war, but only two of these were important—that in St Peter's at Louvain, and that of the famous Cloth Hall at Ypres. But those at Mechlin, Antwerp, Bruges, Ghent—the greatest quartet in the sky—have even been improved and are now more clearly perfect than ever before. France laid claim to forty carillons a dozen years ago, Germany to twenty. Only a score were left to other nations, including the English and Scotch sets and those in Ireland.

Although most Belgians have their favorites among the "Big Four" carillons that rejoice their nation, foreign comment inclines to favor the ven-

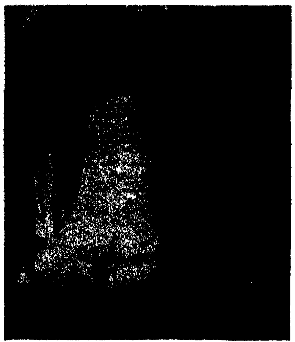

Specially photographed for the Scientific American by Brown Brothers

ANTON BREES, CARILLONNEUR

of the Park Avenue Baptist Church. Note the method of striking a chord. Three bells are rung on the keyboard and two on the pedals erable instrument in St. Rombold's Tower at Mechlin; the more so that the master of these bells is Josef—or, as Belgium says, "our Jef"—Denyn, greatest of living carillonneurs.

Adequate expression of tone can be gained only when the handles and pedals of a carillon keyboard, or *clavier*, are directly connected with the clappers of the bells. But it is only recently that it has been possible to arrange these connections in such a manner that the playing of a carillon would not overtax with exhaustion the performers at this most arduous of musical instruments. Happily most of the chief Belgian sets now have both a keyboard for artistic recitals and also a mechanical connection with the town clock.

The lesser carillons may be altogether mechanical.



Specially Photographed for the Scientific American by Brown Brothers

A STRIKING CONTRAST

The small 12-pound bell and the big 9-ton "toller"

Hence one hears the carillon playing in Belgium or Holland at stated hours on Sunday, on market days, at festivals, and so on. Jef Denyn thus welcomed President Wilson with "The Star-Spangled Banner" when he visited Cardinal Mercier. But it is automatic playing that is heard four times an hour, and sometimes twice as often, from the belfries of each town. National melodies, operatic airs, hymns or folk songs are constantly repeated in a familiar order, although the program, which is always composed of really fine music, is changed several times each year.

A carillon bell is tuned quite as accurately, and far more permanently, than the best of pianos. The pitch or note goes higher as the diameter of the bell decreases; the volume or loudness falls off as the bell loses size and weight. How Franz and Pieter Hemony, greatest of Belgian founders, tuned their bells in the Seventeenth Century is not known; but in the modern process 1,500 tuning forks are used. Gillett and Johnston, English founders who produced the equipment which has recently been installed in the Park Avenue Baptist Church, New York, by John D. Rockefeller, Jr., in memory of his mother, have rediscovered, it is said, the secret of the mellow richness, the wondrous individual harmony, so long restricted to the Hemony bells.

By means of a recent improvement to the console (that is, the striking apparatus, keyboard included), the same makers have removed a serious physical obstacle to the cultivation of carillon art. By hanging the larger clappers near the inner side of the bells, and by using a clever system of counterbalances, the keyboard touch has been so lightened that the writer was enabled to strike with his little finger a cannon-boom upon the nine-ton bass of the instrument in the tower of the New York church.

Although this carillon is quite the largest, comprising no less than fifty-three bells—four octaves and a half—the three or four octaves of accurate, musical, chromatic notes in each of the big sets permits the interpretation of an inexhaustible variety of the world's best music. It must, of course, be music appropriate for such a medium—but every instrument presents a like demand. The range of the new American bells is from E below the bass clef to second A above the treble.

In the recitals or special concerts, such as those three times a week at Mechlin—

> "Saturday for country folk
> And Monday for the city;
> Sunday for girls who charm the men
> And make themselves so pretty."—

difficult music is not uncommon. Bach's intricate "Fifth Prelude," for example, was the special rendition at a notable competition of bell masters held at Mechlin in 1910. But a typical program was that presented by Jef Denyn, four years later, on the exquisite Hemony bells of the Antwerp Cathedral. This program included Verdi's "Jerusalem"; "Lob der Thranen" from "Rosamunde"; Schubert's "Fruhlingsglaube", Nicolai's "Third Sonata," and works by Jef van Hoof, John Diedrich and Peter Benoit.

Rockefeller Gift a Masterpiece

Because of the special conditions inherent in bell music the most effective compositions for the carillon have been written by distinguished carillonneurs, and especially by their acknowledged chief, Matthias van den Gheyn, bell master of Louvain in the Eighteenth Century. Among fifty of his extant works, the "Fugues," not inferior to those of Bach and Handel, are full of plaintive melody, and are marked by strange effects that only skilled bell masters can fittingly interpret—such as the long pedal note, lasting three or four bars, in harmony with a running treble. Some such ethereal music must have awakened Victor Hugo when he wrote upon a window pane in Mechlin his dainty verses about a Carillon Spirit descending from the skies upon a crystal stairway and scattering from her silver raiment magic notes upon the world.

Specially photographed for the Scientific American by Brown Brothers

OUTSIDE THE TOWER

The big bells are housed on the roof of the church

All these fascinations of an unfamiliar art may yet delight America because of Mr. Rockefeller's gift. In addition to a carillon never surpassed nor even equalled, he has supplied the permanent services of an eminent Belgian carillonneur, M. Anton Brees, the son, and, until recently, the assistant, of M. Gust Brees, who as bell master of Antwerp and organist of the Cathedral, has upheld the classic traditions of his predecessor, J. F. Volckerick. First of the leading carillonneurs to visit the United States, Anton Brees gave recitals last year upon most of the carillons that have been multiplying in this country since 1922, the time that the New York bells were ordered. These instruments may now be found in many cities. The first, and for many years the only, carillon in the United States was that imported from France in 1870 by Saint Joseph's Cathedral at Buffalo, New York. Until lovers of all these bells heard Mr. Brees' dexterity, they did not realize what treasures they possessed.

Specially photographed for the Scientific American by Brown Brothers

THE CLAPPER OPERATING MECHANISM

A close up view of one of the huge bells

Canada has several carillons, and Ottawa will equip its Parliament buildings with a duplicate of the Rockefeller bells, which have become a model for the world

Concerning his $60,000 instrument, Mr Brees says that he can only support the unanimous testimony of leading masters who tested the new carillon when it was set up temporarily at Croyden—that it had never yet been equalled.

The installation at the Park Avenue tower, however, is only temporary, awaiting the facilities of a new church at Riverside Drive and 122d street. Incidentally, it was at this corner that a national carillon, "The Bells of History," was to be erected in accordance with plans announced by artists and others three years ago A "Peace Tower" carillon in Washington was another national tribute which has been previously discussed, but which has not yet materialized.

Eight of the bass bells, the largest weighing 19,000 pounds, are now walled in on the roof of the Park Avenue church, the forty-five small bells, including an angel-voiced "baby" that weighs twelve pounds, are suspended in the relatively low tower. Shut in by high buildings on several sides, the splendid carillon is well-nigh smothered; its song is scarcely audible six blocks away.

Bell Master Brees, accustomed to his ancient instrument, 300 feet above the market place at Antwerp, accepts Jef Denyn's dictum that 300 to 400 feet above the street is the necessary level at which to dominate a city and broadcast the carillon message for miles in all directions. To hear this message best, William Gorham Rice, the carillon Blackstone, recommends a station 500 feet from the bells and in full view of the belfry.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Conducted by Albert A. Hopkins

A self-adjusting jaw wrench

A Pair of Useful Wrenches

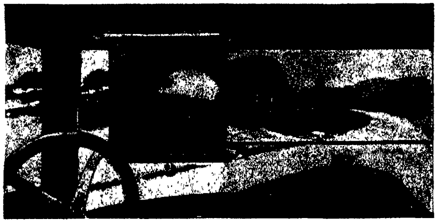
NOTHING is more useful around the home, the farm or the automobile than a good wrench The two wrenches illustrated on this page are alike in general construction except that the one above has a self-adjusting jaw, adapting it particularly to work on bars or pipe The one on the right is a "plier wrench" and is adjustable It can replace a complete set of solid wrenches within the range of action of the jaws. It grips equally well across the points or on the flats of square or hexagon nuts

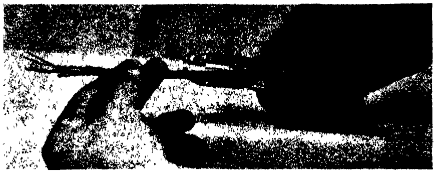
A Roller Shade for the Automobile

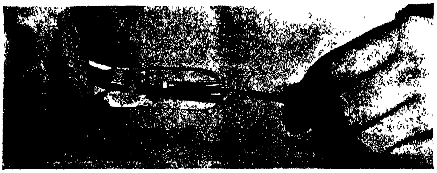
THE device illustrated is a new all year-round protection for the eyes. It shields against the glare of the sun, bright lights, and winter's bright snows It is made of green celluloid and is fastened to a wooden roller on which the transparent shade rolls up. Cloth strips are sewed on both sides and ends These strips prevent the shade from coming in contact with itself, when rolled, and therefore preserve its cleanliness It is operated and installed in the same way as is a window shade.

A Cord and Wire Stripper

SOME of the wire strippers we have seen are very clumsy and expensive The device shown can be easily carried in the pocket. It cuts, strips and burnishes electric cord and wire without the use of a knife, and also replaces cutting pliers It strips double or reinforced cord as well as single. It is adjustable for use in cutting and stripping all commonly used cords and wire, making a clean shear-cut, leaving no ragged edges on the insulation The cord stripping is done with one motion The directions read "Adjust the cutters carefully, cut the insulation and pull" It is not necessary to twist the cutter It is equipped on the side with a powerful set of shears and thus does the work of common cutting pliers To strip double or reinforced cord the outside covering is first severed with the knife projecting from the end of the side cutting blade as shown in the illustration Then the two cords are separated and the stripping proceeds. To strip solid wire the cutters are adjusted so that they are a trifle larger than the wire. This is done to avoid nicking. A twist cuts all the insulation, then the pliers are pulled If carefully adjusted, the insulation can be removed and the wire burnished with one operation The wire should be burnished with the side of the jaw


A roller shade to protect the driver from glare


A safety device which replaces the knife for slitting coverings


Stripping the cord with an ingenious tool

Seals Juice in Pie

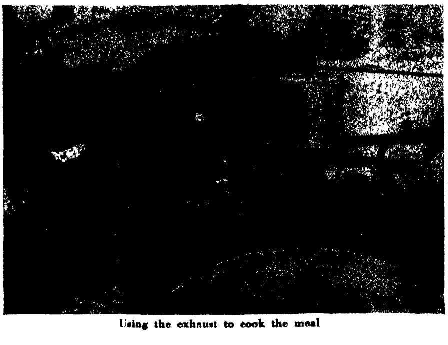
AN enterprising housekeeper has found a new use for paper tape. It is wrapped around the edge of pies to keep the juice in! It is moistened slightly before it is wound around, and since the paper shrinks as it dries, it pulls the edges of the pie tightly together. It is easily removed after baking.

A paper seal for pies

A useful plier wrench

Cooking by Exhaust

A MECHANIC of Columbus, Ohio, has invented a device by which motorists may now utilize the exhaust from their motors to cook their camp suppers. The contrivance uses a small petcock to close the exhaust pipe. A pipe connection is fitted to the exhaust manifold and joins with a round circular burner This burner is provided with circular ribs, to prevent exhaust flames from jumping Similar ribs are built to the bottom of pots and frying pans to obtain a maximum of heat When the motor is idle the exhaust heat is forced through the burner Sufficient heat is generated for any outdoor cooking.

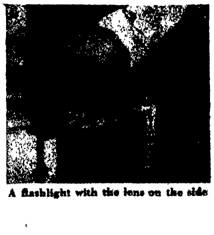

Using the exhaust to cook the meal

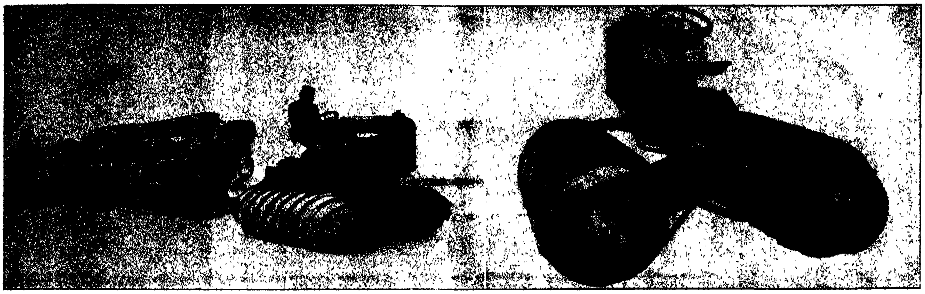
A Handy Flashlamp

A NEW flashlight, designed to aid the man who needs both hands on the job, has just been developed by a New York manufacturer It differs from the conventional style of flashlight in that the lens is on the side instead of at the end It is equipped with a steel clip which makes it possible to attach the flashlight to a belt or pocket and throw a beam of light upon the task to be done, leaving both hands free for the work It is particularly adapted for linemen in the employ of public service corporations, for night repairmen in industrial plants, for maintenance gangs; for repair gangs on bridges, culverts tunnels, et cetera, and for the lone motorist with engine trouble or a puncture.

French Railway Accidents

THE French have been having bad luck recently with railway accidents. In one case eleven passengers and a guard were killed. The driver was subsequently arrested because his speed recorder showed that the train was running at 58 miles per hour instead of the specified 25 miles per hour. There was considerable telescoping and a news dispatch says that the engine and first fourteen carriages, normally filling a length of 552 feet, were compressed into 390 feet.


A flashlight with the lens on the side


A tractor is mounted on blunt-nosed drums revolving in opposite directions passing over fields of snow and ice

A Motor-tractor for Snow

THE running gear of the tractor shown on this page consists of two large, blunt-nosed drums revolving in opposite directions on lengthwise axles Around the drums, in opposing spirals, runs a continuous vane or fin, called the "skate," which acts against the snow precisely as do the blades or buckets on the screw propeller of a ship Once the clutch has been let in, the turning of the drums is controlled by the steering wheel. Each drum receives its power through a separate clutch which, depending on the position of the steering gear, engages or disengages. During recent tests, the snow motor has traveled, at twelve miles an hour, through snow drifts that balked a horse. To mount the tractor on the snow motor chassis it is necessary merely to remove the tractor's front and rear axles and wheels; then the driveshaft is connected to the special gearbox that contains the double steering clutch, the steering gear is hooked up, and the outfit is ready to go

Headlight signal for automobiles

Are Your Lights On?

INASMUCH as the law requires that the headlights of a vehicle be lighted at certain times, it is important that the driver be able to determine whether his lights are on or off at all times An inventor of Reading, Pennsylvania, has devised a simple means of conveying this information to the driver. The invention, shown on this page, consists of a relatively small reflector attached to the upper portion of the lens rim of the headlight, in such position that the driver will be sure to get a reflection of the lighted lamp If he does not get such reflection, he will know that the lamp is out

A huge trailer for carrying heavy machinery

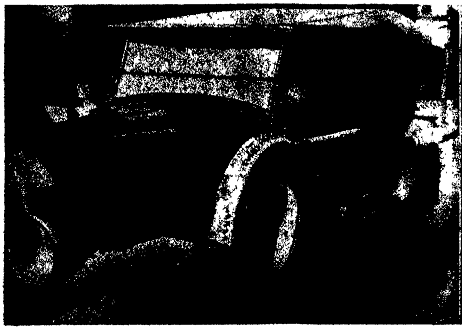
Front of the headlight

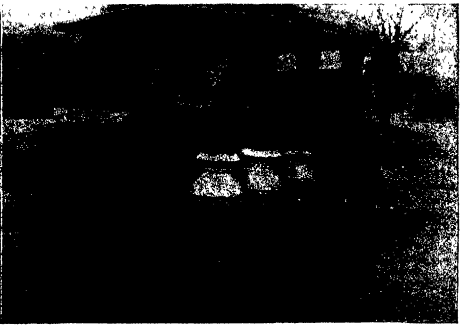
Novel Luggage Carrier

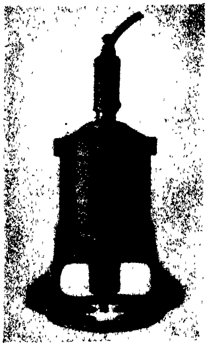
A NEW luggage carrier is of particular interest in that it may be used for quite a number of hauling purposes by making slight changes in its position It is adjustable to running boards of various lengths and may be folded down out of the way so that it will not detract in any way from the car's appearance Four wing nuts control the carrier, and sixteen different adjustments may be made Three steel tubes are welded to steel end-plates and the entire carrier is mounted on the running board by four bolts One end of the carrier telescopes so that one size of carrier may be adapted to any length of running board.

Largest American-built Trailer

THE trailer illustrated is of 30-ton capacity and was built primarily for the purpose of hauling glass making machinery The trailer weighs 10 tons The bed is 9 feet wide and 20 feet long, the main body being 13 feet wide and 35 feet long. It has six wheels two in front and four in the rear The rear wheels are mounted on a main axle in tandem fashion, with a smaller axle connecting the forward and back wheels of each pair The four back wheels are 40 by 12 inches in size and the two front wheels are 40 by 14 inches


An automobile carrier with sixteen adjustments


The farmer can adjust the luggage carrier to hold milk cans



A portable router

An All-Around Router and Hand Shaper

WE illustrate two devices which are very useful in any shop and particularly so in the pattern shop In the router which is shown in detail at the upper picture and in use in the two lower ones, the motor is in the head and rotates the router shaft to which the chuck is secured The hand shaper fits the hand conveniently and consists of a small motor which does many small chores of heading, cutting or grinding.

Chlorine Gas Bomb Makes Possible Home Treatment of Colds

The chlorine gas bomb is of glass and contains pure filtered chlorine gas

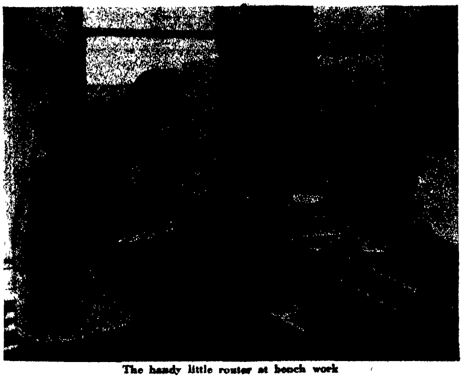
TWO San Francisco chemists have just perfected a chlorine gas bomb which makes possible the use of chlorine gas for the treatment of colds in the home, where the same results are obtained as with more elaborate apparatus. In fact, it eliminates the necessity of going to some central source for treatment, with possible exposure to bad weather and further lowering of body resistance The chlorine gas bomb is made of glass and contains nothing but pure filtered chlorine gas. To use it, the patient takes the bomb in a closed room and breaks off the ends of the bomb, thus permitting the gas to escape and mingle with the air in the room The patient remains in this gas filled room for one hour

A Holder for the Elusive Slide Rule

ONE of the chief services rendered by a new type of slide rule holder, having rubber pads underneath to prevent slipping when in use, is that it permits the time-study man, the accountant, the engineer or the mathematician to operate it, using only one hand, while the other hand is free for figuring and other work The upper part of the slide rule holder is held against the rule with internal coil-springs and the slide rule can be inserted or taken out at will.

A slide rule holder that saves motion

The portable hand shaper in use



The handy little router at bench work

Protecting the alms box

Protecting the Poor Box

TO remove temptation from children and professional robbers, a Chicago safe man has recently invented and is now marketing a cleverly designed burglarproof safe, with three-inch walls, for use in Catholic churches to replace the usual candelabra box, in which offerings are deposited. Following an epidemic of robberies of church offering boxes in Chicago, many of these safes were installed, with the result that the robberies ceased. The safe has an ingeniously designed arrangement of chutes through which coins drop when placed in slots in the top of the safe Three slots are used for receiving three kinds of offerings. The coins pass into a chute and fall into the compartment reserved for the particular denomination for which they are made. To prevent stealing of paper money and coins by the lowering of a sticky substance on string through the chute, the end of each chute has sharp teeth cut into it, thus preventing the return of anything passed into the safe.

Saving Your Eyes From Fine Print

A MAGNIFYING glass attachment for telephones enables the telephone user to find numbers in the telephone book quickly. The glass folds over toward the left when not in use, and is thus out of the way. This will be a great help to everyone who dreads the bulky volume with its fine type.

Find your number!

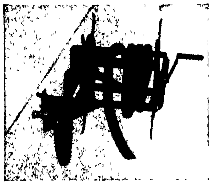
A temper-saving screw driver

Screw Driver Holds Screw

A RECENTLY patented screw driver is so made that it holds any screw by its slot. Because it is a small screw driver (7¼ inches long with ¼-inch blade) it starts screws easily in difficult places. By applying pressure on the top, two steel clips are released from the tool. When the screw driver is placed in the slot of the screw and pressure released these clips spread apart securing themselves tightly in the slot of the screw.

New Stationary Hose Reel

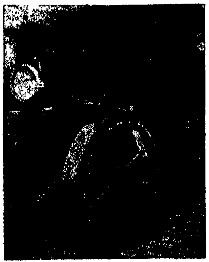
THIS is a stationary hose reel which may be attached to your house by a bracket. This reel has a short length of hose which connects the water outlet to the axis of the reel, where it is connected in turn to the ordinary section of garden hose length.



A hose reel for the house

A New Way of Teaching Geography

TO create interest in geography lessons, boys of the eighth grade manual training class of the Avondale Public School, Cincinnati, have made an electrical map of South America whereby the teacher, by pressing a button, can flash on one or more miniature lights concealed behind the map showing the location on the map.

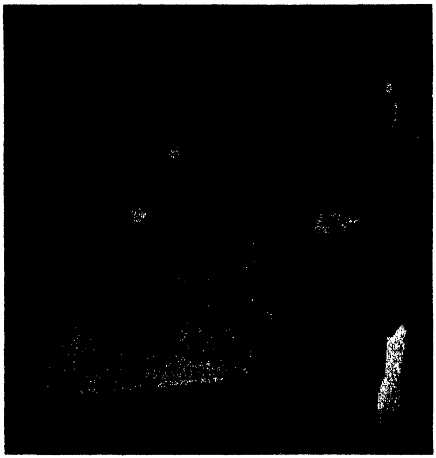


A mud guard that works

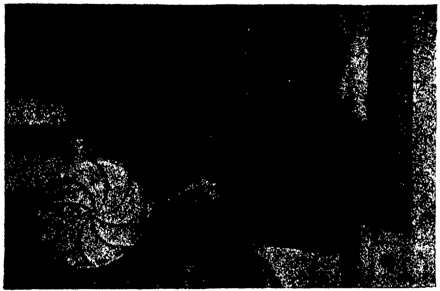
An individual lemon squeezer

Mud Guard for Pedestrians

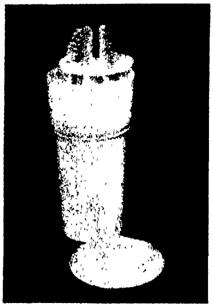
THE mud guard pictured here is the invention of W. Peterson, a shipowner of Leith. This mud guard, which can be attached to any truck or bus, protects the pedestrian from the outward spatter of mud



An illuminated map for the geography class



The ribs spread the heat



A porcelain sterilizer for toothbrushes

Sterilizes Toothbrushes

THE brushes are held by a porcelain disk with numbered holes for six brushes. A germicidal solution, the ingredients of which are volatile, is poured into the container once a week. No part of the brushes comes in contact with the solution.

A Woman's Idea of an Efficient Sweeper

MRS. E. M. BOLTON, grandniece of Sir Humphry Davy, has invented a "concertina" stair carpet sweeper. The dust is swept into the side tray as shown in the engraving.

A concertina stair-carpet sweeper

A Press for Plastic Substances

SO many objects now are made from plastic materials that special machinery is necessary to fabricate them. It is intended that this press be equipped with two sets of molds so that one set may be loaded and unloaded while the work in the second set is being pressed and cured.

A plastic molding machine

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Courtesy of Bulletin des Recherches et Inventions

This photograph shows the Renault Gazogene motor truck, with the centrifugal *purifiers set just ahead of the engine*

Courtesy of Bulletin des Recherches et Inventions

The Vierzon Gasogene truck illustrates a type of installation similar to the Renault, but without *such complicated purifying devices*

Trucks Make Their Own Fuel

The accompanying photographs, showing a method of generating fuel gas for motor vehicles from charcoal, which has been rather extensively tried out in France, illustrates, to our mind, a tendency which has been apparent in Europe since the World War—a tendency to attempt to accomplish by complicated methods what is already being accomplished through simple means.

Gasoline, it is true, is expensive in France; and that nation feels insecure about its motor fuel supply, owing to the fact that it has no internal sources of gasoline Gasoline must be imported, and a wartime blockade would bring about a situation that would be nearly fatal to a nation that is motorized even to the extent of France

The "gasogene" generator is a cumbersome, bulky and heavy apparatus, attached to one side of a motor truck or to one end of a farm tractor It generates fuel from charcoal France is liberally supplied with sources of charcoal

The apparatus consists of a generating chamber having a grate, firebox and boiler for producing the necessary steam for making the gas It appears to be an amazing complication of internal "gadgets" The gas must be scrubbed, filtered to remove particles of charcoal, and further purified in a centrifugal purifier There are a number of other details which it seems unnecessary to mention here

The results of the tests of these gas generator vehicles have been so far exceedingly satisfactory, according to the reports of the *Office National des Recherches et Inventions.* It was found that they can travel along an ordinary road at the rate of some forty miles per working day, hauling the regular maximum load of the truck

On bench tests it was found that the motors developed nearly as much power as when running with gasoline The gas utilized did not clog up the cylinders appreciably more than does ordinary gasoline

As to endurance, the gas-generator run truck is stated to be just as hardy and strong on the road as is the gasoline truck And, most important of all, the economy of this fuel runs in France anywhere between forty and seventy five percent

* * *

Aiding Digestion in Gasoline Motors

Much has been said regarding the available sources of petroleum and gasoline left in this country and authorities are more or less contradictory in their views on this important subject But it remains a fact that our crude oil resources are being gradually depleted The publicity that has been given to this matter has had one significant result, namely, an endeavor to improve the combustion of the gasoline air mixture in the cylinder of the internal combustion engine, so that increased efficiency may be obtained and the consumption of fuel reduced

Considerable attention has been paid to the incorporation of ingredients with gasoline to remove the "knock" in the engine and to increase its efficiency The real value of such added ingredients, from all standpoints still seems to be within the realms of discussion and experimentation Another interesting and important method of developing more power in the engine and removing the "knock" forms the subject of this article

The process of catalysis is well known in the chemical and allied industries A catalyst is merely a substance which, through its very presence, makes it possible for certain chemical reactions to take place or which accelerates the speed at which they ensue Catalysts are of various natures Some are metals, others metallic salts; still *others are compounds of the non metallic* elements It is a fact that the catalyst does not change or diminish in quantity during the chemical reactions, but after a time it becomes fouled, loses its catalytic potency and must be replaced. This does not, however, have to be done except after considerable use has been made of the catalyst, so that one mass of the reagent will last for a very long time

The most recent application of catalysis is to accelerate the combustion of gasoline air mixtures in the engine cylinder. The catalyst is applied to the head of the cylinder by simply painting it on, the active principle being incorporated with other ingredients to form a paint. The organic constituents of the paint are then burned off and the catalyst remains on the cylinder head.

An engine that has been treated in this manner possesses important advantages, for the catalyst, in accelerating the combustion of the gasoline by making it more complete, promotes the efficiency of the engine, with the result that greater energy is obtained from a unit amount of gasoline. This new development consists essentially of the application of catalysis to the process of conversion of chemical into mechanical energy in the cylinder

Detonation, known as "knocking," is due to the decomposition of the unburnt fuel in the cylinder It is a phenomenon which has been held to be brought about by too rapid combustion But this theory is apparently erroneous For it is a fact that certain substances added to the fuel tend to decrease the "knock" It, therefore, is plausible to conceive of the action of these substances as serving to increase the velocity of combustion of the fuel within the cylinder to such an extent that decomposition does not take place to so great a degree as heretofore

It is understandable that a substance cannot both burn and decompose at the same time. This is the theory advanced by Dr Edward Sokal, the inventor of the catalyst—which is called Katalite Thus, contrary to the theoretical views usually maintained on this subject, "knocking" in the motor has actually been eliminated by accelerating the combustion of the fuel in the cylinder

The active ingredient in the paint preparation, the catalyst, is a salt of the metal cerium After this paint has been burned off from the cylinder head, an oxide of cerium is left This cerium dioxide is the accelerating catalyst.

When the combustion of the gasoline-air mixture is accelerated, it is evident that leaner mixtures can be used than are now practical Leaner mixtures catalyzed allow effective pressures to be obtained at lower temperatures, with the result that internal cooling of the engine is accomplished without entailing the loss of energy that is occasioned by external cooling All this means greater fuel economy.

Extensive tests have been made with the new fuel economizer, and while results differ according to the design of the engine, and while under certain conditions it has been possible to augment appreciably its power production, in practically all tests it has been possible to duplicate the manufacturers' best performances with much leaner mixtures. Such motor engines as the Locomobile, Willys Knight, Ford and Packard Twin Six have been tested, and good results have been obtained in all cases.

In making a further analysis of the detonation problem it becomes evident that there are other ways of reducing "knocking," such as multiple spark plugs, and the central location of the spark plug; but all these remedies really accomplish nothing more than an increase in the rapidity of combustion. The use of a catalyst to accelerate the combustion of the air-gasoline mixture is the chemical method of solving this problem; and inasmuch as combustion itself is a distinctly chemical process, and since catalysis is known to have an extraordinarily great

Applying the catalyst to a gasoline motor with a brush

accelerating effect on the velocity of chemical reactions, it is not surprising that it is so markedly effective. The important point to remember is that the fuel remains the same. Nothing is added or subtracted from the gasoline. All that has to be done is to paint the cylinder heads with the catalytic preparation. It is claimed that one application will last for 15,000 miles.

According to Ralph H. McKee, Professor of Chemical Engineering at Columbia University, who has been conducting some experiments with gas engines whose cylinders were treated with a catalyzer, the recently discovered accelerating action of catalysts, such as cerium dioxide, on the combustion of gasoline-air mixtures is theoretically correct and promises to go far in permitting us to meet our hopes of better working and more economical automobile engines.

* * *

Courtesy of Hileman, Great Northern Railway Co

At present the railroads are attempting to extend the average "run" of their locomotives, which is less than 200 miles. This locomotive made a 3,571-mile, practically continuous run from Seattle to Saint Paul and back

A Wonderful Long-Distance Locomotive Run

ONE of the marked developments in the railroading of today is the tendency to increase the length of individual railroad runs, both the length of runs without a stop and also the total length of runs with stops made uninterruptedly by the same locomotive. The Great Northern Railway is greatly pleased, and justly so, by what may be regarded as the most remarkable engine performance to the date of Friday, September 25. On that day, the company's passenger locomotive Number 2517 left Seattle, Washington, at 4.30 in the afternoon with eighteen cars of raw silk and one passenger coach coupled up behind it, and made the run to Saint Paul without any stops, other than those for coal, water, and so on, in 52 hours and 35 minutes, reaching Saint Paul at 11:05 P M Sunday, September 27 This silk train, by the way, was the largest individual silk shipment ever transported in the Northwest

The next morning, September 28, the same engine was coupled to train Number 27, which is the fastest long-distance mail train in the world, and left Saint Paul at 9·05 A M. It made the through run from Saint Paul to Seattle, a distance of 1,789 miles in 47 hours 10 minutes, reaching Seattle on time (although it was delayed 20 minutes in starting from Saint Paul) at 5.15 A.M., Wednesday, September 30, the average running time being about 38 miles per hour It should be noted that, because of the 20-minute delay in starting, engine Number 2517 made better time than the regular schedule of Number 27 by 20 minutes

It will be seen that the round-trip performance of this engine, from Seattle to Saint Paul and return, a total distance of 3,571 miles, was 99 hours and 45 minutes, something which has never before been accomplished on any American railroad It should be noted that the average distance traveled by a single locomotive running on the regular schedule is the distance between division points, which averages from 150 to 200 miles How exceptional this performance was, is evident when the time consumed for fueling and watering the engine has been taken out, for in ordinary practice the replacing engine is already fueled and watered

The fact that this was a stock engine and one of a fleet of oil burning passenger locomotives which haul the Oriental Limited, and the further fact that it was not especially prepared for this great effort, renders the continuous round trip of 3,571 miles the more remarkable

* * *

How They Do Petty Road Repairs in France

BEFORE the World War, France boasted of 900,000 miles of splendidly kept roads, built with crushed stone The mobilization of every available Frenchman during the war and the necessity of confining road repair work to those of the roads which were at or leading to the front, had the effect of allowing roads in the center, west, and south of France to deteriorate rapidly

Formerly taken care of almost from day to day by the "cantonniers" or repairmen stationed in every village and on the outskirts of all the small or large communities, the roads of France after five years of neglect were found to have been damaged to such a degree that in many cases it was necessary entirely to rebuild large stretches of the important "national" highways

The necessity of paying for the war and rebuilding the devastated regions did not allow for the adoption of a lavish policy in this matter, for the cost of such work was prohibitive

In each case the government experts had to choose between two policies either to replace a large proportion of the roads by new roads built with the strongest materials known to modern engineers, or to repair methodically and with perseverance the existing damage to the present roads The second policy has been followed out, but old methods had to be replaced by new and better ones

Before the war the "cantonniers" had several tasks to perform The ditches along the road had to be constantly watched and cared for in order to permit of the drainage of rain water Weeds and other plant-growth had to be removed from the road side lest *they invade the road itself* And lastly, the road worker would go from hole to hole and from rut to rut, filling them with the rocks which he had broken by hand and which were kept in little heaps beside every road Those who motored through France before the war will recall the busy men breaking stones with sledge-hammers at the roadside or sweeping pebbles from the highway with large brooms

The modern method is more expensive, but it is said to be far more efficient and rapid The equipment used also represents a greater initial expense and a higher operating cost than the cost of the pre-war manual labor

The work of repairing holes in the French roads is undertaken in much the same manner as that of a dentist who fills a cavity in a tooth. The cavity is first located, the road is dug up around the cavity, and a "filling" is inserted

A rectangular outline is drawn in chalk around the rut or the hole, and then a workman with an electro magnetic pick axe proceeds to break up the road within the outline The debris is cleared away, and the new material is prepared for filling the excavation

Then the cavity is filled in and pounded in with an electro-magnetic tamping machine After the filling-in process, the surface of the road is remodeled exactly to its original level, and the job is done

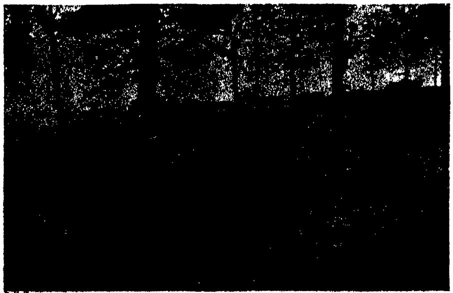
The electro-magnetic pick-axe is a powerful tool, driven by an electric motor, and both the tool and its motor are supported by an axle suspended between two wheels. The workman grasps two shafts connected with the axle, and thus guides the tool over the ground; the force and depth of the blow can be gauged by bearing down on the shafts

The tool strikes sharp, powerful blows and does not scatter the material dug There is no known road material that can resist its cutting edge The power which operates the motor is derived from overhead wires by a trolley attachment This permits the tool or tools to operate over a considerable area of the road without moving the generator which provides the electric current to the motors

After the hole has been dug, the filling materials are mixed by hand, because mechanical mixing machinery would not be practical for the detail work for which the apparatus is designed In every case, whether the road be of concrete, crushed rock, or macadam, the material previously used in the road is made the basis of the filling, and similar materials are added if there is not enough The holes are filled by hand, and now the electro magnetic tamper comes into play It operates with great speed and strength, leaving the surface of the road in much the condition in which it stood after the steam roller finished its work when the road was first built The tamper, like the "pick-axe" or road breaker is provided with a motor and is carried on an axle between two wheels, with shafts handled by the operator, and the electric energy is obtained from the trolley attachment

The entire repair squad is composed of a dozen men, and all the men and their equipment are carried on a single truck This truck contains an electric generator driven by a gasoline motor While repair work is in process a number of low towers provided with the proper insulation are erected at intervals along the road bearing the power wires from the truck The latter remains stationary while work is carried on over a distance of several hundred feet

As soon as a stretch of road is repaired, the ladders and power wires are removed and the truck proceeds to work on a new location


F. M. Delmas

In France, road repair work is done by means of an "electromagnetic pick-axe" which opens up small damaged spots

F. M. Delmas

The opening made by the electromagnetic pick-axe is filled and another tool is attached to the motor for tamping

Seeing in the Dark

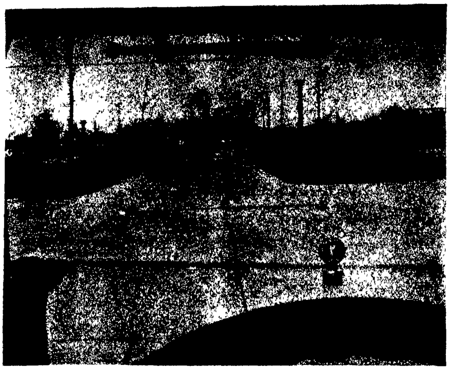
IT is a matter of common experience that insufficient road illumination and glaring headlights make night driving conditions far from satisfactory Various devices—special lenses, reflectors, and so on—have been presented to relieve or to cure these conditions, but glaring headlights still levy their toll of accidents, and statistics show that even more accidents are due to insufficient road illumination Yet, an immediate and far reaching improvement in night driving conditions would be effected if motorists realized the following two facts

(1) With the majority of headlamps now in service, proper adjustment is all that is necessary to obtain greatly improved road illumination, and at the same time to eliminate objectionable glare.

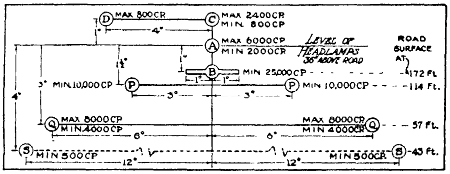
(2) A driver who makes the proper adjustments now, without waiting for others to make them, not only removes the irritation he is causing other motorists, but also provides for himself a road illumination that is better and safer and one that makes it easier for him to pass cars with glaring headlights

From the two small headlamps, mounted three feet above the road, a way must be found to direct a path of light over its entire surface for 200 feet or more ahead, a little light close by and to the sides to illuminate roadside and ditch and to assist in making sharp turns, and tens of thousands of candlepower just below the level of the headlamps to reach well ahead and reveal *obstructions, turns, crossroads, and dead end* streets At the level of the headlamps and slightly higher there must be some light to reveal pedestrians, and anything *that* overhangs the road before one is upon it But here the intensity of the beam must be closely limited, unfortunately, to a small fraction of that needed just below the level of the headlamps if the approaching driver is not to be blinded in its dazzling glare—actually to much less than is necessary to reveal the road far ahead for fast driving

The best compromise must be effected between the need for a high candlepower to reveal objects ahead, *on the one hand*, and, on the other, the necessity for controlling the light above the lamp level so that while some glare *remains serious* interference with vision is avoided The chart shows the limiting candlepower values in the directions of the different points indicated on the photograph, needed to insure such a beam *Modern headlighting regulations of many* states are based on a similar system specifying minimum performance


Courtesy of National Electric Light Co

The beam must be toed-in, so that it misses approaching traffic



Courtesy of National Electric Light Co

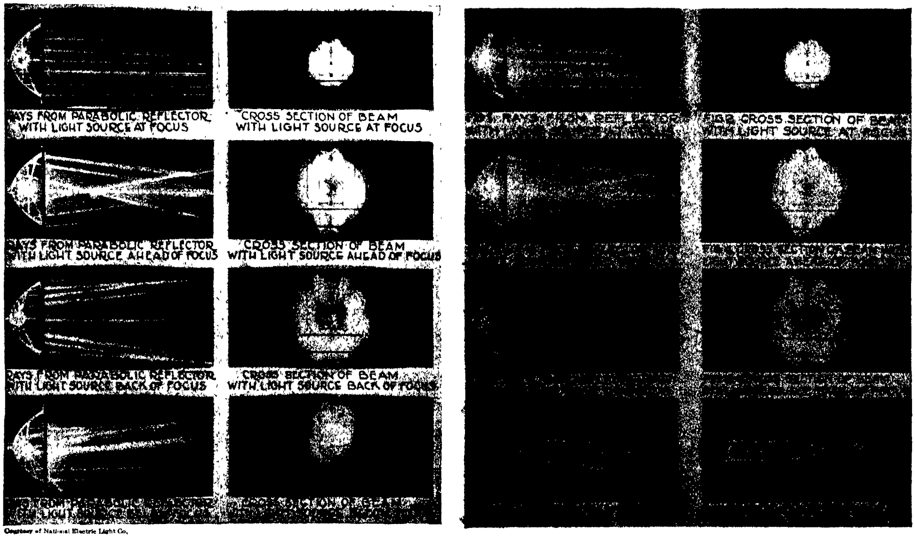
This diagram is directly analagous to the illustration above

The desirable type of beam, as indicated, utilizes the light from the headlamp bulbs most advantageously But in doing this the light is taken from all directions and concentrated in a narrow zone. Darkness remains all about There is no light in the direction of road signs or house numbers; the beam is not wide enough to guide one *safely around the sharp curves of an* unfamiliar road except at the slowest speed. On sharply hilly roads the beam is often completely lifted off the road or, striking a steeply ascending grade, is cut off just ahead of the car, and for fast night driving, safety always requires more light above the horizontal than is obtained with the approved headlight equipments Spotlights supplement the headlighting adequately under any of these conditions and may be needed to substitute for the headlamps in an emergency Judiciously used, the spotlight is valuable from the standpoint of all concerned, *while injudiciously* used it may pave the way for legislation penalizing the majority for the inconsiderate acts of a very few Fortunately, the greatly improved headlighting conditions today over those of a few years ago have almost entirely removed the occasion for misuse of this valuable accessory. No car should be without a good spotlight

No matter how well designed or efficient the headlamps on the car may be, good road illumination without blinding glare cannot be expected unless the bulbs are accurately adjusted in the reflectors and the beams are *properly aimed* State approval on a particular lens or special reflector means simply that the device is so designed as to be capable of distributing the light in a satisfactory manner—but only when properly focused and aimed

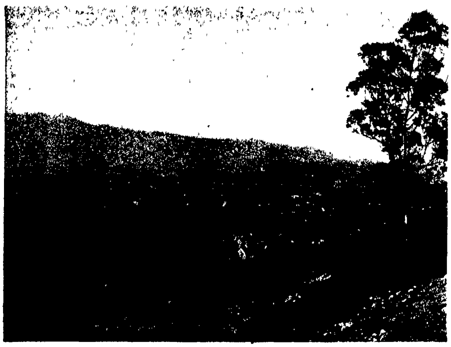
Given good equipment, with the optical parts clean and shiny, all that is needed to insure good results is adjustment, which means two things (1) Focusing the lamps; (2) Aiming the beams

"Focusing the lamps" is an imposing technical phrase to describe the simple opera-

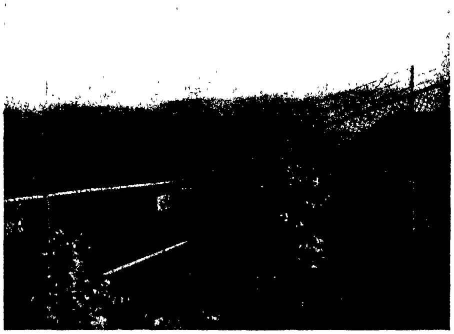

RAYS FROM PARABOLIC REFLECTOR WITH LIGHT SOURCE AT FOCUS
CROSS SECTION OF BEAM WITH LIGHT SOURCE AT FOCUS
RAYS FROM PARABOLIC REFLECTOR WITH LIGHT SOURCE AHEAD OF FOCUS
CROSS SECTION OF BEAM WITH LIGHT SOURCE AHEAD OF FOCUS
RAYS FROM PARABOLIC REFLECTOR WITH LIGHT SOURCE BACK OF FOCUS
CROSS SECTION OF BEAM WITH LIGHT SOURCE BACK OF FOCUS

Courtesy of National Electric Light Co.

The reflecting element of the automobile headlight is a parabola with but one focus. It is necessary to adjust the light-source until it occupies that exact point



In California, when it was found necessary to irrigate land bordered by a fence, the top pipe of the fence was utilized as the water main



A section of the fence, showing how expansion due to heat was taken care of by means of a swing joint at the corners of the long sections

tion of moving the lamp bulb a little ahead or back by means of that ordinary tool kit implement—a screw driver, while "aiming the beams" is just that—tilting the headlamps downward and swinging them from side to side as one would nod or turn his head, until the beams point straight ahead at the right up-and-down angle This will probably require the services of no more complicated an instrument than an ordinary monkey wrench.

When you move the bulb ever so little in the reflector something very noticeable happens to the beam Look at the pictures These are actual photographs of three types of beams obtained from the same lamp and reflector.

None of the three beams shown are of a satisfactory type to answer the requirements of good headlighting, because all of them are round, while what we really need is a flattened form of beam This desired type is obtained either by using a lens on a reflector of the type shown, by using a reflector with especially designed contours, or by a combination of the two. In any case there is always some one position of the lamp bulb which gives us the best shape of beam. Focusing should be done with the lens in place and this is all there is to it—simply moving the bulb a little ahead or a little back in the reflector so as to marshal the rays into an orderly formation that puts the light where it is wanted

One fundamental principle frequently used for this purpose is the fact that a wedge or prism of glass will bend light rays off at an angle The shape of the wedge or prism together with its position determines where the light ray that passes through it will be directed.

Place the car on a level stretch with the headlamps 25 feet from a light-colored vertical surface.

Some means, which can be determined upon examination, is customarily provided for moving the bulb backward and forward in the reflector, usually a screw head projecting from the rear of the headlamp Cover up one of the headlights. Now, move the bulb in the other back and forth and notice the changing patterns on the reflecting surface Our object is to get a light pattern as shallow as possible in the up-and-down direction with the top edge of the pattern sharply outlined. The brightest part of the pattern should be as near the top of the beam as possible because this is the part of the beam that lights the road far away. If your bulb is of the ordinary single filament type take it out and turn it over in the socket, and use it in the position which best fulfills the foregoing condition. Focus the other headlamp in the same way

Next aim the beams so that when the car is fully loaded the tops of the beams will be directly ahead of and at the same level as the headlamp centers If, when the car is empty, the beams are aimed to meet the requirements, loading the car fully will tilt them upward into the eyes of approaching drivers Therefore, if the car is not loaded when the aiming is done, an allowance must be made in the tilt of the headlamps

Measure the height of the headlamp centers from the floor, and, if the car is empty while you are making this adjustment, subtract a loading allowance figure of from 5 inches for 140-inch wheelbase to 8 inches for 110 inch wheelbase, and draw a horizontal line at this level on the vertical wall Then draw bisecting vertical lines the same *distance apart as the centers of the lamps*

A universal joint or a slot under one of the bolts fastening the headlamp to the fender or frame is usually provided to facilitate aiming With one headlamp covered center the pattern below the bisecting point directly ahead so that its upper boundary is on the horizontal line

Cover the adjusted headlamp and repeat the operation on the other one

Check your headlighting occasionally

At reasonable intervals, the adjustment should be checked roughly to be sure that vibration and handling have not changed the focus and aiming Throw the beams against a vertical surface or view them from about a hundred feet ahead of the car and see that the top edge of the beam is at about knee level

Incorrect voltage on the lamps is sometimes the cause of unsatisfactory headlighting If the lamps seem to burn with a dim or yellowish light, a low voltage is indicated, this may be due to poor contacts in the lamp circuit or to an under-charged battery, which is frequently the result of a generator charging rate too low to replace the electrical energy used by the starter, lights, and other electrical equipment on the car Repeated early lamp failures indicate a high voltage on the lamps, this may be caused by poor contacts in the battery circuit, by lack of water in the battery, or by an over charged battery, caused by an excessive charging rate

In either case, the condition of the battery and of the circuits should be inspected, preferably at a service station, in order to avoid the danger of serious trouble, as well *as to obtain satisfactory lighting service*

Good headlighting, therefore resolves itself into the use of good equipment and the correct adjustment of that equipment *Both of these conditions are necessary and* each is dependent upon the other Most of the headlight troubles at present are due to poor adjustment A good safe driving light for the pleasure and safety of the motorist is the spirit of all headlighting laws Headlight adjustment is not intended primarily for the other fellow's benefit—it is for your own —Abstracted from a booklet written by Dr M Luckiesh, Director, Lighting Research Laboratory, National Lamp Works of the General Electric Company, and Corresponding Editor of the Scientific American

* * *

Combining Fencing and Irrigation

The idea of the top rail of the fence carrying water to irrigate the Forest Lawn Memorial Park in Glendale, California, was worked out by the Southern California Fence Company The cemetery is located on a hillside the highest point being about 1,800 feet above sea level Coincident with the question of fencing was the problem of how to irrigate and water the vines which were to cover the fence

The first idea was irrigation by an underground water line system, except at the highest points, where the water was to be conveyed by buckets This, however, involved too great a cost It was finally decided that the underground system could take care of the low portion of the ground The slope is to be irrigated by making leads from the top rail of the fence at intervals *to desired locations infield In this manner* the property owners were spared the expense of laying main underground supply lines

The fence is approximately 13,000 feet *in* length, the top rail being 1¼ inch pipe The water supply is taken from a storage tank at the highest point of the fence line *Along this fence English ivy vines have* been planted about one foot apart and eucalyptus trees about five feet away from the fence and 12 feet apart This planting is continuous around the entire property, except for 300 feet at the entrance gates In watering these trees and vines a hose is connected to the valves in the rail and operated by hand

One question about this installation was that of caring for contraction and expansion of the pipe, as some of the straight lines are more than 3,000 feet long A swing joint was constructed in the pipe line at the fence corners forming the circuit This safeguard, plus the manner in which the wire was fastened to the water pipe, solved the problem

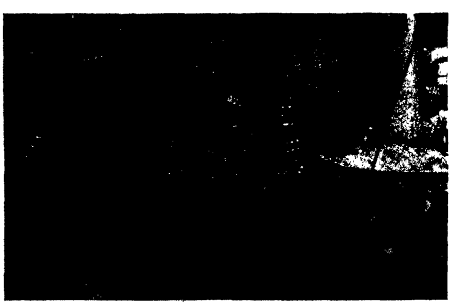
The Forest Lawn Memorial Park is one of the most beautiful cemeteries in Southern California, being situated among the hills on the borders of the cities of Glendale and Los Angeles It consists of about 212 acres entirely enclosed with fencing When the planting along the fence attains its maturity the fence will be almost entirely covered with English ivy, forming a dense screen The eucalyptus trees will form a hedge line which, in time, will extend 200 feet high

* * *

Food Preservation by Inert Gases

In 1922 the Scientific American published a short article giving the results of the experiments made up to that time in the preservation of foods

At that time great hopes were entertained *that the inert gas packing process would be* very generally applicable to food preservation To a great extent those hopes have been fulfilled, says Mr Thomas M Rector, author of "Scientific Preservation of Food"



Food products and tobacco packed in an atmosphere of inert gas, instead of oxygen, do not lose their desirable qualities

In general, the beneficial results which have been conclusively proved for the Vita pack process, as this inert gas process has been named, may be summarized as follows:

All foods containing oxidizable oils or flavoring substances are benefited if active oxygen is removed and an inert atmosphere of carbon dioxide or nitrogen gas—that is, one which will not enter into chemical combination with the food—is substituted for it. Foods, such as nuts of all kinds, dry milk, candies containing butter fat, and others, fall into this class. Foods which are subject to the attack of molds (which ordinarily require oxygen for their development and growth) are also protected by the effects of an inert gas atmosphere.

In order to secure freedom from the action of bacteria and yeast, it is usually necessary partly to dehydrate the food in order that it may be protected from molds by the gas process, and this is now being done in the case of canned coconut, to the extent of ten million cans per year. So effective is this process in the case of nuts, that it now permits cashew nuts a delicacy of India, to be brought ten thousand miles to this country in perfect condition. Before the development of this process, these nuts almost always arrived badly infested with worms. Most of them were in such bad condition that the Department of Agriculture was compelled to condemn them as unfit for human consumption.

Canned coconut was the first product to which this system was commercially applied. Coconut is a milky white product which spoils very readily. When attempts were made to can it, it soon turned black in the cans, presenting an unappetizing appearance.

This was due to the fact that the oxygen occupying the space between the threads of coconut attacked the tin can, producing black metallic oxides. These oxides rubbed off on the coconut, blackening the threads. The obvious remedy was to remove the oxygen as thoroughly as possible and this was best accomplished by the substitution of an inert gas in its place.

When this process was put in use it was found that not only did the coconut remain in a pure white condition, but the flavor was very much superior to that canned without inert gas. The cause of this was traced to oxidation of the coconut oil and it was then realized that an unanticipated advantage had been secured.

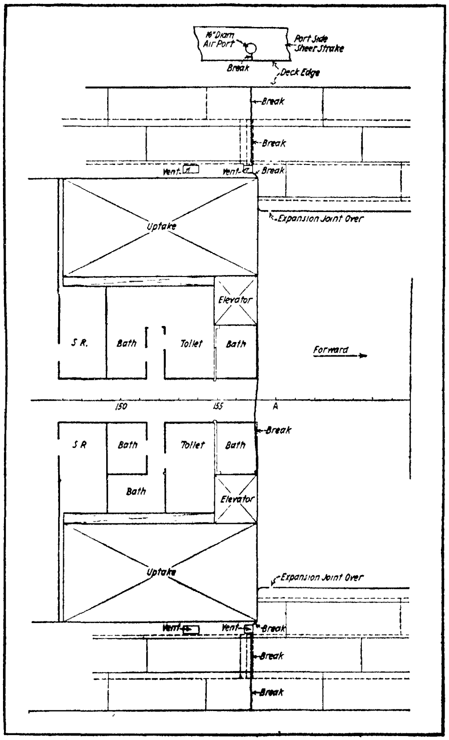
No advantage has been attained in the preservation of liquid milk, either in its natural state, or condensed, but in the infant dried-milk industry it has fitted in well. Dry milk, which is simply milk which has been evaporated to a powder, is a very delicate product and is extremely sensitive to the influence of the atmosphere. By packing it in an atmosphere of inert gas, in a hermetically sealed container, it has been possible to preserve dry milk for as long as three years, with no signs of rancidity. Ordinarily, rancidity in dry milk exposed to the air in an ordinary metallic container may be expected to show in from two to four months. This, however, is not long enough to allow the milk to pass from the factory to the consumer, and the fact that an occasional can has reached the consumer in a rancid condition has been a great detriment to the development of dry milk. Dry milk packed by the Vitapack process is now being sent to all parts of the world.

In dry milk, the predominant cause of spoilage is again the oxygen of the air and if this air be all removed and a chemically inert gas be substituted, there can be no oxidation. Because the milk powder is extremely dry, danger from insect infestation and the growth of molds is very slight.

In the enormous tobacco industry a great deal of experimental work has been done, and two or three firms are already putting out tobacco packed in inert gas, in commercial quantities. It has been predicted that within a year, 75 per cent of the plug tobacco of the Dominion of Canada will be packed in hermetically sealed containers. This is because the long dry winters of Canada are very detrimental to the "condition" or moisture content of tobacco of all kinds, so that it is necessary that it be maintained with the *flavor and moisture exactly right*.

This fact also applies to smoking tobacco, cigars and cigarettes. The mysterious "blending" or "smoothing" processes which go on in tobacco aged in proper condition are greatly benefited by this system because none of the flavoring oils can be lost, and therefore, the tobacco is really aged in a flavored atmosphere, which is conducive to proper blending.

It has been found that practically all nuts, including walnuts, pecans, brazil nuts, filberts, cashew nuts, pistachio nuts, and others more rare, can be kept as long as desired, if properly prepared in advance. The preparation consists chiefly in proper drying. Since these facts were established by research, several firms have started packing shelled nuts in sealed tin containers.



Courtesy of Marine Engineering and Shipping Age

Looking down on C deck of the *Majestic*, showing the break that extended entirely across it and started down the side

During the World War, and for a time afterward, there was a great deal of enthusiasm among food manufacturers about dehydrated foods. This enthusiasm was largely based on the extreme claims of manufacturers of drying equipment and others that dehydrated foods would keep forever, once the water was removed. However, there is no dehydrated food—with the exception of those practically chemically pure, such as sugar and starch—which will keep indefinitely under ordinary atmospheric conditions. Insects, molds, and rancidity caused *by oxygen—all take their toll.*

Loss of flavor by evaporation and by other causes also comes into play. Therefore, manufacturers who packed their dehydrated foods in paper cartons and put them on the market, soon found that their products began to spoil within a few weeks.

It should be quite obvious to anyone, even the manufacturer of dryers, that the future of this very important industry depends on being able to convey the product to the consumer in such condition that when it is soaked in water it comes back to a condition resembling that of the fresh fruit or vegetable. This, it is claimed, can be accomplished better by the inert gas system than by any other method.

* * *

Why "Majestic" Was Laid Up for Repairs—Faulty German Design

LAST winter, the *Majestic*, the world's largest steamship, was making her westward passage in rough weather when a loud report, likened by many to a cannon shot, was heard. An investigation showed that the C deck of this mammoth vessel had cracked open all the way from the starboard to the port side, the crack even extending a short distance down the side of the ship. She was able to make port, one day distant, and to return to England, where she was laid up for repairs.

This is the report of Edward Ellsburg, a naval constructor of the United States Navy, contained in the August, 1925, issue of *Marine Engineering and Shipping Age* (New York).

It would appear from Mr. Ellsburg's account that it was discovered, during the summer of 1924, that the C deck of the *Majestic* was fractured at the midship section. The C deck is the strength deck of the vessel, but it had been largely cut away by two elevator shafts and two uptakes which cut the double plating. This construction, according to this United States naval constructor, results in leaving only about twenty-five percent of the beam of the ship intact inboard of the elevators and uptakes.

This plating near the center was not intended to take any strain and was made only five-eighths of an inch thick, as compared with the deck-stringer plating which is about two inches thick at the side and about one and one-half inches thick in the strakes next inboard.

It was the section of five-eighths-inch plating between the elevators which was first discovered to have parted, but at the time little importance was attached officially to the fracture. As this light plating was not the strength plating, the vessel was not considered weakened and, as it was then in the midst of the tourist rush, nothing was done to remedy the damage. It was apparently intended to defer repairs to some slacker period in the future.

However, says the United States naval constructor, "a little reflection, and a further investigation at this time as to how a light strake could ever get sufficient strain to let go when there were outboard of it heavy strakes intended to take all the strain, would have proved both illuminating and profitable. There can be no doubt," he continues, "that such an investigation would have shown the deck stringers on both sides already fractured through a considerable portion of their width, so that the strains in working had been partly thrown on the light strakes inboard, with the consequences noted."

The C deck was concealed by wood planking, and underneath, the stateroom ceilings sheathed it, and "if anyone connected with the ship had any doubts, they were not strong enough to cause the laying open to inspection of the deck stringers, and no examination of them was made."

Matters continued in this status until the westbound trip in December, with rough weather, and it was then that the loud report, like a cannon shot, was heard. The C deck had let go clear across, the port shear strake had already let go, so that the crack started down the side until it met and was stopped by a porthole not far below. But the ship made port all right and sailed east again according to schedule. The crack opened now about one-half inch as the ship worked, but the weather was now not bad and Southampton was reached where the ship was laid up for repairs. The wood decking and the ceilings below were ripped out.

Then it was found that although an opening had been cut for the uptake hatch, there was no *compensation* for it fitted around the corners of the opening. This and other factors produced a line of weakness and, in addition, failure to compensate the heavy deck for the openings cut in it, resulted in concentrating all the strain carried from forward by a much wider strake of heavy plating. The fracture was progressive. This occurred in the summer of 1924, and it was only in December, in rough weather, that the remaining metal of the top flange of the deck let go with a bang.

Just why the German designer of the *Majestic* failed to compensate his strength deck when he cut out an oblong section of it on each side is not known.

The *Majestic* was repaired with heavier materials than the original, and is now in regular service.

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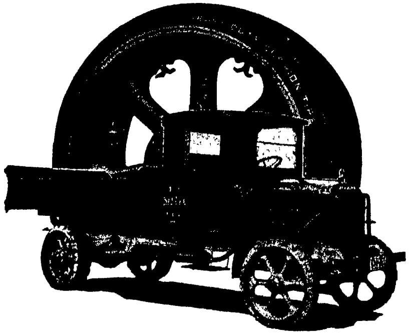

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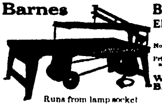

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Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics

Pacific and Atlantic

This is not a helicopter. When the usual airplane type of propeller moves the craft forward, a huge windmill is set into rotation and the area swept out by the windmill blades being inclined to the line of the wind, acts just like a fixed wing in providing lift

La Cierva's Autogiro

LA CIERVA'S Autogiro of which such interesting reports have recently appeared in the daily press, is *not* a helicopter, that is, a machine in which a power driven air-screw provides the sustention or lift of the craft It is based on a different principle

As shown in the photograph, it is constructed with an airplane fuselage, the usual type of landing gear, the ordinary type of rudder and elevator controls, with ailerons of the usual type carried on tubes from the lower part of the fuselage, and the customary type of engine-driven propeller to secure forward movement But instead of having fixed wings, it is supported in the air by a large four-bladed windmill, perfectly free to rotate on a long shaft, inclined slightly backwards emerging from the front cockpit and braced by a pyramid of steel tubes. As simple experiment will show, a windmill, suitably designed, will rotate in a side wind, although the aerodynamics of the side-wind rotation are somewhat intricate As the windmill rotates, any element of the blades meets the air just like a wing section and, therefore, provides lift The windmill, therefore, becomes the equivalent of a lifting surface If the tail is depressed and the shaft inclined back from the vertical, the plane of rotation of the windmill is at a bigger lifting angle and just as with an ordinary wing the lift for a given wind speed increases There is no perpetual motion in this functioning of the windmill, it only rotates and provides lift if the airplane propeller is dragging it forward with energy supplied by the engine

The newspapers speak of a combination of flapping and rotation The device has no flapping wings, properly so-called, but the blades of the windmill do move up and down slightly as they rotate, and that for a very important reason Imagine the blade on the lift side going forward into the wind of the forward motion of the Autogiro, and the blade on the right side retreating from this wind Evidently, the blade on the left side is meeting the air at a greater resultant velocity than the blade on the right side. If the blades were rigidly fixed to the shaft, the Autogiro would have more lift on the left side and would constantly tip sidewise. M La Cierva spent several years in overcoming the difficulty The final solution is most ingenious. The arrangement adopted is shown in our sketch.

The blades of the windmill *a* are attached to the collar *b* which is free to turn about the shaft *f*. But they are hinged at the point *e* so that they are free to take up various positions, as shown dotted in the sketch. Rubber bands *s* prevent the blades from coming too far down, when they are at rest. The blade moving forward on the left side does momentarily experience a greater lift than the blade on the right side sailing away from the wind, but owing to this momentarily greater lift, the blade on the left side rises As it rises, it meets a down wind which automatically diminishes its lift. There is, therefore, an automatic and perfect lateral balancing, with the blades of the windmill moving up and down through a few degrees as they rotate

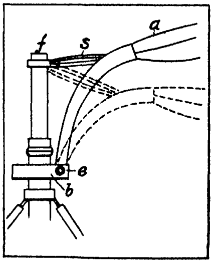
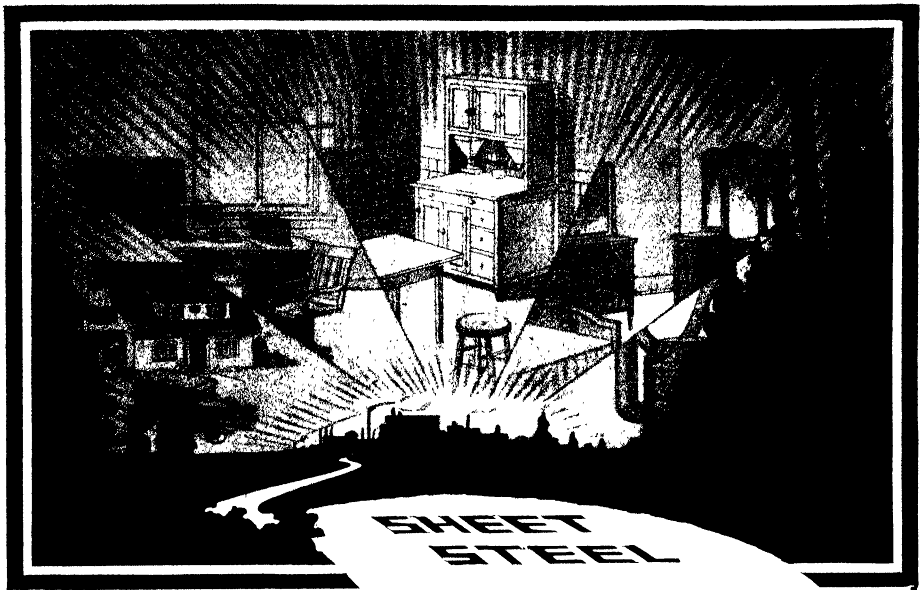


Diagram showing how the blades of the windmill are attached. M. La Cierva spent several years working out this arrangement

Wherein lies the *fundamental advantage* of the Autogiro? In the fact that with an ordinary airplane, the lift of the wings is dependent on the forward velocity alone. If the airplane is moving forward very slowly, the lift becomes too small to sustain flight. In the Autogiro, the speed of the resultant wind on the blades is compounded of the forward velocity, *plus* the rotational velocity. Therefore, the craft as a whole is capable of moving very slowly while the blades are rotating rapidly and giving a large lift accordingly. The Autogiro is, therefore, capa-

(Continued on page 50)



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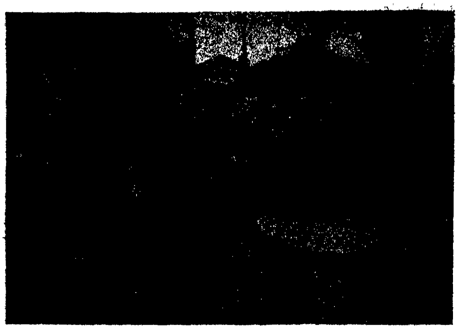


Wide World

Mr. Daniel Guggenheim with Chancellor Elmer A. Brown at his side, breaking ground for the Daniel Guggenheim School of Aeronautics to establish which he donated $500,000 to New York University

ble of flight with a forward velocity much smaller than that of the airplane, which fact has obvious advantages in getting-off and landing.

Before starting a flight, the vanes are set in motion by hand A cord is wrapped round four pegs—one on each vane—and pulled by men on the ground. Otherwise the vanes would take too long a time to accelerate. This expedient is only one that would be employed in an experimental machine, some form of starting gear would be embodied in a normal machine.

Having started the vanes, the engine is opened up and the machine proceeds to roll normally. For a short time nothing seems to happen, but suddenly the vanes noticeably fold a little upwards, their speed of rotation increases and the machine seems to jump into the air some five or six feet Thereafter, it behaves very much like an ordinary airplane. If the tail is held down it climbs, with the fuselage horizontal it flies horizontally and, if the nose is pushed down, it descends. With the engine off, it will glide down at very much the same sort of angle as an airplane. It turns well and shows no sign of swinging on a turn

But, if the tail is held down at an angle approximating to the stalling angle of an ordinary airplane, the Autogiro keeps the air at a very small forward speed, estimated at 20 miles per hour If the engine is cut off and the tail is depressed still more, the Autogiro descends on a very steep path only 30 degrees away from the vertical, and yet has a downward velocity of only two feet per second, and a very slow forward speed Accordingly, not only does the Autogiro land in a very small space, but it rolls not more than 30 feet after touching the ground Conversely, it can get off the ground very quickly and climb on a steep angle.

Therefore, while the Autogiro does not realize the requirements of an ideal helicopter by *rising and descending vertically* and hovering, it comes close to achieving these requirements Even though the fuselage did smash up on the last trial by Frank Courtney, the British pilot, the Autogiro has possibilities as regards safety and the ability to utilize a very restricted space for both get-away and landing. The present Autogiro has a speed of 68 miles per hour, but the inventor claims that with suitable design very great speed can be attained. It is too early to prognosticate what the efficiency of the craft will be, and it is certainly a disadvantage to have to rely on rotating parts for the lift, these can never offer the security of fixed wings, yet the Autogiro's further development will bear watching

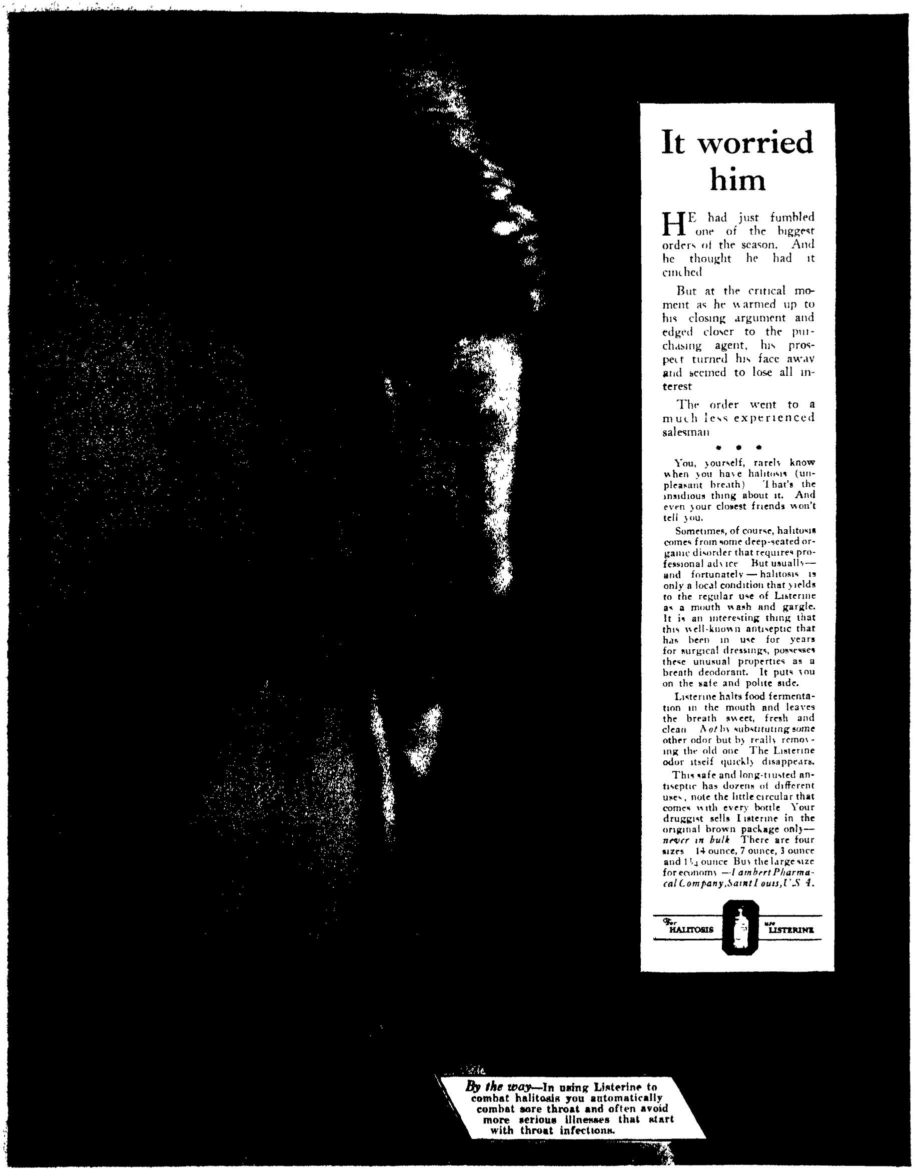
All-Metal Airplanes

HENRY FORD *is not only operating an* airplane from Detroit to Cleveland and from Detroit to Chicago, but he has purchased the Stout Metal Airplane Company which is responsible for the construction of the planes employed in this service These planes are built entirely of metal, duralumin, and the views of William B. Stout, their designer, on the subject of all metal airplanes are, therefore, particularly interesting Mr Stout discusses the subject admirably in a paper before the American Society of Mechanical Engineers

In the design of airplanes, aerodynamic efficiency, lightness of structure, and durability are among the most important objectives Why are other designers as well as Mr. Stout *seeking to replace* wood and fabric construction by metal? Not on the score of aerodynamic efficiency A plane built of wood may have precisely the outward form and aerodynamic characteristics of the all-metal plane Not on the score of

(Continued on page 52)

Figure 1. The Stout metal airplane ready for service. Planes of this type fly regularly between Cleveland and Detroit and Chicago and Detroit



It worried him

HE had just fumbled one of the biggest orders of the season. And he thought he had it cinched.

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* * *

You, yourself, rarely know when you have halitosis (unpleasant breath). That's the insidious thing about it. And even your closest friends won't tell you.

Sometimes, of course, halitosis comes from some deep-seated organic disorder that requires professional advice. But usually—and fortunately—halitosis is only a local condition that yields to the regular use of Listerine as a mouth wash and gargle. It is an interesting thing that this well-known antiseptic that has been in use for years for surgical dressings, possesses these unusual properties as a breath deodorant. It puts you on the safe and polite side.

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Figure 2. One of the main wing spars or beams being built up in a jig

lightness Wood, though it is less strong than metal, is also far lighter One reason why designers are turning to metal is because metal shows far less variation in strength One piece of wood may be far better than another, while metal always gives approximately the same characteristics Hence, a metal structure is far more determinate in its strength Another reason is that metal construction is far more durable than that of wood and fabric and renders unnecessary the use of such perishable substances as glue which can stand neither extreme tropical heat, nor the tremendous cold of the Far North

The Stout all metal plane is a splendid example of metal construction and deserves close study.

Figure 1 shows the Stout plane ready for service. It has an internally braced monoplane wing, with no resistance-producing external parts, and it is equipped with that good old stand-by of American aviation, the 400 horsepower Liberty motor, which though it is now surpassed by many modern engines, still maintains its commercial supremacy because of its relative cheapness and because every pilot and mechanic is familiar with its characteristics It has a wing spread of 58 feet 4 inches, a length of 46 feet 2 inches Empty, that is without fuel, oil, crew or pay load, it weighs 3,717 pounds Fully loaded, with pilot four and a half-hours' fuel capacity, and a commercial pay load of 1 080 pounds, it weighs 5,849 pounds, all told. It has a maximum speed of 115 miles per hour, a cruising or commercial speed of 100 miles per hour and can climb to a "ceiling" of 15,000 feet The cabin has an enormous cubic capacity for an airplane, namely, 250 cubic feet. It is possible, therefore, to carry eight passengers with their baggage in roomy comfort, or to carry a large number of packages which may be light yet bulky—for example, a shipment of ladies' hats which may be very light yet require much space.

The commercial pay load is less than a fifth of the total weight of the airplane In this respect our flying machines are still far inferior to land traveling vehicles. But the plane has heavy air loads and landing loads to meet and it develops a speed far in excess of any other method of transportation, so that even this ratio of pay load to gross load is no mean achievement

It is of the most refined structural design The entire structure is of duralumin This remarkable alloy of aluminum has the strength of ordinary mild steel, when properly heat treated, but weighs only one third as much For the same weight, duralumin is no stronger than modern alloy steel which possesses remarkable strength, running as high as 200,000 pounds per square inch in tensile tests. But owing to its lightness duralumin permits the use of bulkier channels or sections In the small members of the airplane, alloy steel used to its theoretical strength would become so thin as to have insufficient local strength to stand handling or riveting Whether duralumin has the same definite character as steel, or whether it resists fatigue as well are still moot questions; but the majority of designers are of the opinion, and Mr Stout is among them, that it forms a more promising material for airplane design than steel

The wing of the airplane is a cantilever structure. It is something like a bridge flying through the air, and its design is

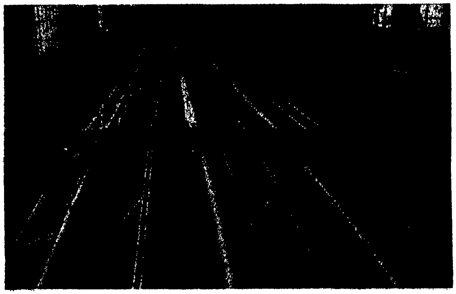
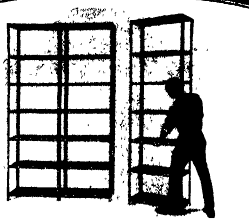


Figure 3. Beginning the construction of the wing. Three main beams or spars are evenly placed inside the wing. Smaller intermediate spars are used as stiffeners to outline the wing contour in between



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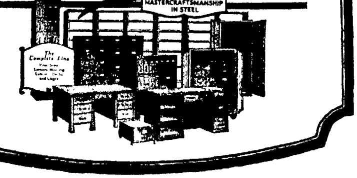

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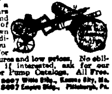

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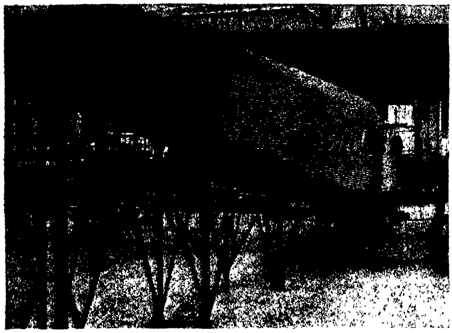

Figure 4. Fuselage being assembled on permanent metal jigs

similar to that of a bridge Figures 2 and 3 show the internal construction of the wing There are three main spars or beams inside the surface, 32 inches deep at the center where the fuselage or body fastens on, tapering out to comparatively few inches at the tip where there is much less bending load to be resisted These beams or spars are evenly placed inside the wings; intermediate or former spars, as shown in Figure 3 are used as stiffeners to outline the wing contour in between When the main spars and the intermediate former spars are in place, corrugated metal rolled to fit the wing curve, is riveted to the spars top and bottom In this way some designers claim that the skin becomes a part of the structure so that the actual surfacing of the plane is obtained for almost no weight, since it is performing the double function of surfacing *and* structure The metal skin, instead of being a liability to the structure as in cloth and wood types, may then be considered a definite structural asset. Other designers are of the opinion that the skin adds nothing to the strength and is a very heavy item to carry through the air This divergence of opinion is far from being ended, but there is this to be said for the metal covering—that it preserves the aerodynamic contour of the wing and prevents flutter of the monoplane wing The whole wing becomes a rigid box, resisting torsion effectively as the resultant air load travels along the wing chord with varying flight attitudes Much research and great expenditure of money have gone into the development of the main spars themselves These spars are shown clearly in Figures 2 and 3 The spar consists of flange or "chord" members top and bottom, with intermediate vertical and diagonal "web" members—very similar to some types of built-up bridge members The flanges or "chord" members consist of a semi-circular rolled section, 1, riveted to a channel section, 2 The advantages of this semi-circular section are that it is easy to make and that the skin or outer surfacing can be riveted to the chord at any angle without extra fittings The channel section below, shown at 2, gives side walls to which the web members can be riveted The wings are continuous across the body or fuselage of the airplane and are fastened to it by six large bolts of great strength, giving a strong yet readily removable connection.

The fuselage, the cabin and some portions of the wings are further illustrated in Figures 4, 5 and 6. The fuselage is more particularly illustrated in Figure 4 It is built up on a jig arranged with a series of cross bulkheads riveted up from duralumin channel sections These sections are bent up in an ordinary tinners' brake and the entire set of bulkheads can be made by four men within two days, even with the simple equipment used As the structure of the fuselage goes back of the cabin, the load is carried entirely by the corrugated skin itself, with stiffening bulkheads at intervals Some of the fuselage channels are shown in Figure 5 In Figure 6 looking through the door into the cabin, we see the interior seats with their upholstery

Figure 5. Interior of the fuselage when the plane is used as a freight carrier

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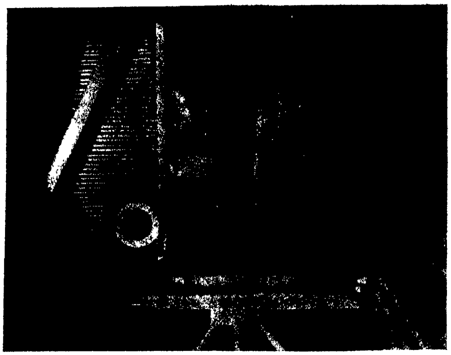


Figure 6. Looking towards the rear from the cabin. This shows details of the wing construction above, arrangement of the cabin, and the bulkheads of the tail structure, as seen from the rear door

A similar all-metal construction is employed for engine mounting, control surfaces and all other parts of the plane

There are innumerable problems to be solved in the metal construction of a plane: how to make the metal covering of the wings really take a fair share of the load; how to cheapen and make more rapid the process of putting in the innumerable rivets required, how to make it quite certain that the rivets will stand up and not produce local cracks and failures under severe vibration as in the engine mounting, how to cheapen the construction by using standardized sections throughout These problems will continue to call for the attention of designers and inventors alike Enough has been said to show that the art of all-metal construction has already reached a stage where it is useful and practical

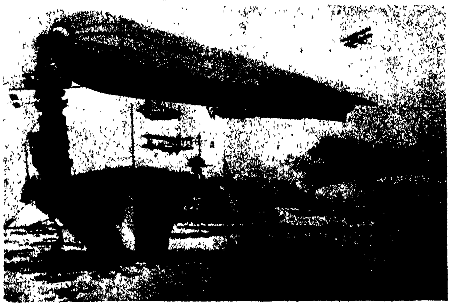
Naval Aviation

EVERY midshipman at Annapolis must now study aviation, and the United States Naval Institute has produced a splendid little book under the above title to meet the students' needs It is far more than a class text, however—its author, Lieutenant W W Warlick, can prophesy and thrill as well as instruct What more startling, and yet more reasonable than the frontispiece, which we are allowed to reproduce herewith?

Here we have a huge aircraft carrier, with broad deck for the landing of navy planes To one side of the deck is a huge mooring mast, with an airship swinging freely at its top—perhaps the reader will improve even on this picture by imagining the airship itself as a plane carrier with small craft suspended from its keel Even then, the picture would not be too fantastic (the *Langley* aircraft carrier, the former tender *Patoka*, with its mast to which the *Shenandoah* was so often moored, and the Army Air Service experiments in hooking small planes on to an airship in flight will be readily recalled by our readers)

At present the most important functions of the naval airplane are auxiliary; they are scouting and spotting Successful bombing and torpedoing of capital ships may come soon Here is a suggestion for another and more terrifying form of bombing: "The whole supply of air for the modern ship is taken from the upper decks and forced by blowers to every compartment and corner. Imagine the effect of a salvo of asphyxiating bombs" International convention prohibits this method of dealing death, but who can tell what may happen in bitter warfare?

An airplane can make a get-away in a hundred and fifty feet and with arresting gear may come to rest after alighting in even a shorter distance Why then the prodigiously long flush decks of the *Langley*? Why not make part of the deck flush and utilize the rest of it for masts, smokestacks, heavy deck guns? Because without a flush deck, the obstructions to the air flow produce unpleasant eddies which may have a disastrous effect on a plane about



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An imaginary photo-sketch picturing an air base at sea, an almost immediate possibility. At the left a huge dirigible is seen moored to a plane carrier of the type used by England. At the right, one is moored to a mother-ship on the type of the *Patoka*

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Polar Pastures

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This article is the latest contribution to the FORUM's survey of the economic, biological, and racial factors which must inevitably determine whether the nations of the world shall be in a state of war or peace.

In the same issue: *Dean William Ralph Inge*, of St. Paul's, G. K. *Chesterton, Philip Guedalla, Rose Macaulay.*

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JANUARY

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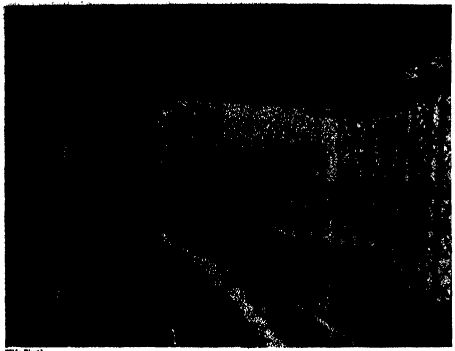


Wide World

Launching of the *U.S.S. Saratoga*, newest airplane carrier

to alight slowly and, therefore, under poor lateral control. With air disturbances, the plane may be set down suddenly and thus break its landing gear, it may suddenly rise and then flop down; or it may be struck by a cross gust and be blown over the edge of the deck. Accordingly when the *Langley* is rigged for flying, there is nothing above the deck, the boat stowage is all below and the smoke is let out at the side.

The new aircraft carriers such as the *Saratoga* and the *Lexington* are not entirely flush, but have an island on the starboard side to include the stacks, mast, bridges, fire control towers, and so on. In such a case the nose of the carrier is headed off the wind a few degrees and the deck is then almost entirely free from eddies and gusts, except in the immediate vicinity of the island.

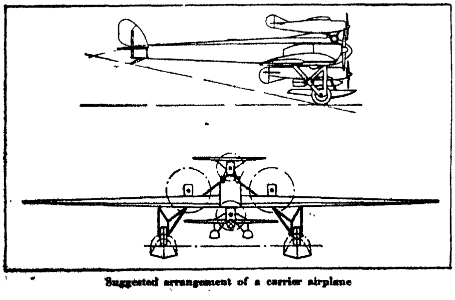
Sometimes naval aircraft on duty with the fleet and lacking the support of aircraft carriers, must work with tenders. The planes alight alongside the tender, are refueled and undergo necessary repairs. A torpedo plane has even been refueled from a destroyer at sea. The fuel was transferred by means of a hose, while the destroyer was rolling approximately twenty degrees.

It is customary to bewail the fact that with the advent of steam, seamanship has disappeared. There should be, if Lieutenant Warlick's description is correct, plenty of opportunity for seamanship in towing a seaplane This is a most delicate undertaking under any conditions. The pilot of the plane, as soon after landing as possible, rigs a sea anchor to reduce his rate of drift. The vessel that is to take the plane in tow, steams slowly across its stern, creating an oil slick if necessary The line is readily picked up as the plane drifts over it If the towing continues for any length of time, the towing gear is as a rule scarcely strong enough to stand the strain In towing all movable weights are placed aft, and it may be necessary on large planes for members of the crew to ride on top of the horizontal stabilizers at the tail of the ship' Hoisting a seaplane aboard is a similarly tricky operation, particularly in a rough sea

But the midshipmen are not to pay attention to scouting or seamanship alone They must, if they are to be naval aviators, be endocrinated with the principles of aerial combat. What could be more inspiring than these graphic sentences: "..... . Captain Ball the first great British ace, and Captain Guynemer They knew neither fear nor caution Fighting alone, by preference, they unfailingly forced combat, impetuously engaging an enemy formation of twenty planes with the same ferocious, smashing attack with which they greeted a single opponent An enemy sighted was an enemy to be engaged by direct approach, along the shortest line, without regard to position or odds."

A Carrier Airplane

IN a previous issue we have described experiments made by the Army Air Service with an airship to which a small Messenger plane was hooked. Now the suggestion, first made by the Germans of building a carrier airplane is revived by a writer in *Aviation* On the giant, rather slow, airplane transport would be mounted smaller planes, detachable at will for purposes of defense or bombardment. The large mother ship would give the long range necessary in military operations; the detachable craft would have nearly twice the speed, and thanks also to its smaller size would be less vulnerable to the anti-aircraft fire of surface vessels The smaller plane could likewise



Suggested arrangement of a carrier airplane

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The Aeromobile as an ordinary airplane of the "baby" type

put up a better fight against rapidly maneuvering combat planes After the completion of a mission the smaller craft might very well return to the mother ship

The diagrams give a rough suggestion of the arrangement of a carrier airplane The engineering difficulties should not be insuperable Nor should the smaller ships be just so much dead weight and parasite resistance to withstand They could be made aerodynamic units of the whole arrangement, responsible for a certain amount of the lift, and with their propellers working in conjunction with the airscrew of the mother ship.

Saving Helium Gas

IT is not for us to state what the exact cause of the *Shenandoah* disaster was The stories are too conflicting and the positive evidence too scanty for even the Board of Inquiry to be sure of arriving at correct findings But it is quite probable that modification of the safety valve systems and the general unwillingness of the crew to valve helium on account of the expensive character of this gas, had something to do with the disaster Therefore, a recent patent of the Schutte-Lanz Airship Company has a peculiar interest

The idea is illustrated in the sketch In the interior of every helium gas cell of a rigid airship an auxiliary cell *a* filled with hydrogen is provided, with a pipe *g* leading clear to the top of the airship

An Aeromobile

IT is always tempting for designers and inventors alike to imagine vehicles which can be used as automobiles or airplanes at will A German engineer, by the name of Maykemper, has built a machine of this type which is at least neat and practical in appearance

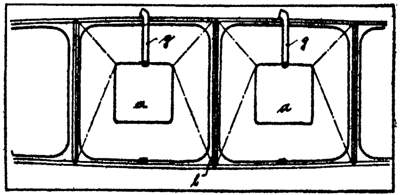
In the first photograph the Aeromobile is seen as a "baby" airplane of clean looking design, with a very low fuselage and the axle going through the bottom part of the fuselage, so that there is a minimum of exposed parts in the landing gear Equipped with a small motorcycle engine, the little airplane weighs only 770 pounds with pilot and fuel for five hours flight.

In the second photograph, the loosening of a few pins has allowed the two outboard parts of the wing to be swung into a vertical position and then to be folded up against the sides of the fuselage The craft is now functioning as an automobile which is only five feet in width and under twenty feet in length.

Atlantic Photo Co. Berlin

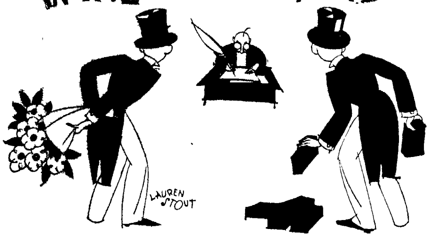
The Aeromobile with its outboard wing sections swung vertically and back and the propeller removed so that it can travel the roads like an automobile

There is no reason to doubt the successful functioning of the Aeromobile in its dual capacity, but it would be interesting to know how the mechanical problem of transmitting power to the wheels in rolling on the ground has been met without prohibitive weight Also it would appear from the photographs that the tail of the machine is provided with a tail skid and not a third



In the interior of every helium gas cell of a rigid airship an auxiliary cell *a* filled with hydrogen is provided with an outlet leading to the top of the airship. Danger of fire is largely eliminated and hydrogen instead of helium is lost in maneuvering

IN THE EDITOR'S MAIL



Curious Geometrical Figures Appearing Upon Mars

From Prof. W. H. Pickering of Jamaica, British West Indies, comes the following interesting item:

> It is a rather curious coincidence that at each of the recent very near approaches of the earth to Mars, strikingly regular, although only temporary, geometrical figures should have appeared upon its surface The well known cross, centered in the approximate circle of Hellas, appeared to Schiaparelli in 1879 (Figure 1) It may have appeared in the unusually close apparition of 1877, but in that year he saw only the circle and the single vertical canal The diameter of the circle is 900 miles The cross has of late years been replaced by an irregular curved structure
>
> The next very close approach of our planet occurred in 1892. In that year a regular pentagon with central radiating canals was seen in Arequipa (Figure 2.) One of the canals was missing, but it may have been too delicate for our 13-inch telescope, or it may have been covered by a temporary Martian cloud when we made our drawing The center of the pentagon was located at Ascraeus Lake, as it is now called, although then unnamed, and the diameter of the figure was 800 miles
>
> In the year 1909 no very complicated figure seems to have been seen The Lowell Observatory published no special report on that apparition, as they had done for some of the earlier years M Jarry-Deloges on September 26 drew Figure 3, which is perhaps more interesting than striking, because large four-sided figures are most unusual upon Mars. The central meridianal canal is Laestrigon, the two lower ones Tartarus and Cerberus The horizontal one, Aesculapius, has become more prominent of late years than formerly, while the two upper ones are rarely seen, but both have been confirmed by later observers The length of Laestrigon is 1,200 miles *(Observations des Surfaces Planétaires, 2, Plate 9)*
>
> At the apparition of 1924 the earth passed closer to Mars than had been the case for over a century, and closer than will be the case again for a century more. This year an unusually large and complicated figure appeared. Again it was pentagonal, apparently a favorite figure with the supposed Martians, but in a still different place. The pentagon of Elysium, which later changed into a circle, is of course well known to all students of the planet It measures 800 miles in diameter, but this one is much larger, measuring approximately double the size Moreover it is not a true pentagon, although of that nature, but a five-pointed star with symmetrical appendages attached (See Figure 4) Obviously so large a figure, formed on a spherical surface, can only appear symmetrical in one particular position of the planet That position happened to be assumed by the earth this past year at opposition, when the planet was nearest to us, and the center of the disk in Martian latitude 16° S Again, to see it properly, the central meridian must be at longitude 0° Dr. Trumpler of the Lick Observatory made the original drawing showing the canals from which this figure is constructed, but as shown by him it is not quite symmetrical, because the drawing was not made with the proper central meridian for that purpose Still, even as he drew it, it is rather striking. *(Pub Astron Soc of the Pacific,* 1924, 36, 266)
>
> Some of the canals which compose it are well known, and were discovered by Schiaparelli, namely Typhonius, Orontes, Phison, Euphrates, Hiddekel, and Protonilus The others were discovered and named by Lowell Indeed he saw all the canals forming the figure, but he saw also many others crossing it, that confused and concealed it He represented it moreover not as seen in the sky, but on Mercator's projection, consequently no one would ever detect from his drawing its symmetrical character. At this apparition it stands out plainly and alone in Dr Trumpler's drawing, in what may perhaps be described, on account of its surroundings and framing, as the most conspicuous possible position upon the planet As above noted, it is in only one position, that occupied by the earth at the last opposition, that the star appears to be symmetrical, for it really is not symmetrical at all as laid out on the surface of the planet itself And if it had been symmetrically laid out, unless it had been located at the very center of the disk, it is most unlikely that we should have happened to recognize its symmetrical character.

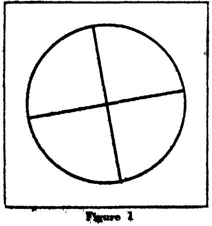


Figure 1

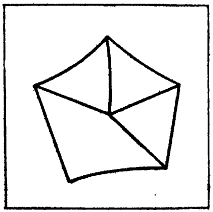
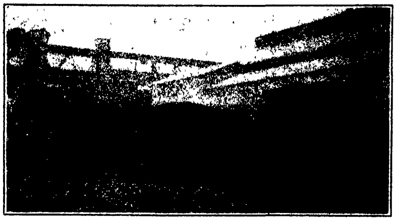


Figure 2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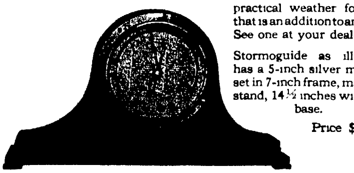
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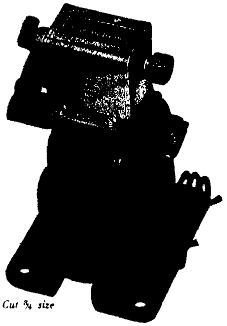
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It is indeed curious that these complicated figures should occur on Mars, and still more curious that they should all be only temporary, and should appear only at the very close apparitions of the planet, while at other apparitions the numerous other canals should present no symmetrical structures There is of course a definite system to their customary arrangement that we are now gradually beginning to understand, and as above noted, the avoidance of large four-sided figures among them is of itself curious. Some people will doubtless believe that these designs are not due to mere accident, but are artificial, and constructed for our especial edification, and as an announcement of the existence of intelligent life on their planet If so, we wish the Martians would plant them out, or otherwise construct them, more frequently than once in every fifteen and a half years If not due in the past to chance, we wonder very much what figure will appear at the next close opposition in 1939 However we must not expect too much of the Martians, and if they have been doing this sort of thing for the last 10,000 years or more, we must consider them to be far more persevering in their endeavors to communicate, than the inhabitants of our own self-satisfied, and very unresponsive planet.

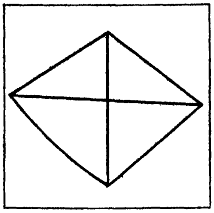


Figure 3

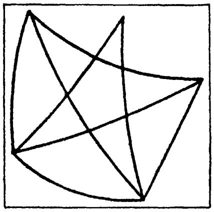


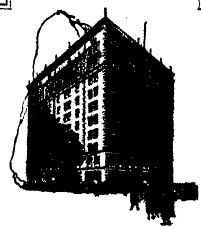
Figure 4

William H. Pickering

Useful Star-gazing

Although you may never have the adventurous experience of being set adrift in a lifeboat or being lost among the clouds, nevertheless, we think you will enjoy this description by Elmer B. Collins, Nautical Expert of the Navy Department, of the "Clock in the Sky"

If you were to blind-fold an expert navigator of a modern ocean liner, ship him to any of the world's seven seas, transport him to any of the various points of the compass, either in the direction of the warm tropical waters of the South Sea Isles, or towards the cold stormy seas of the frigid zones, and, then after removing the bandage from his eyes, you were to supply him with nautical almanac, sextant, and chronometer, set to the time of Greenwich, in twenty minutes, after he has observed the altitude of a couple of stars, his whereabouts will be known to him within a mile or so. Is not this an amazing triumph for the worth and usefulness of practical astronomy? Surely the movements of these numerous cosmic bodies are for other purposes than sentimental star gazing.



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December 1, 1925.

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The men in prison are clothed, fed and sheltered far better than in years gone by, but as ever the greatest suffering falls upon the innocent in those prison-shadowed homes We find them hungry, poorly clothed and often sick and despairing Many would have no touch of Christmas joys but for our help.

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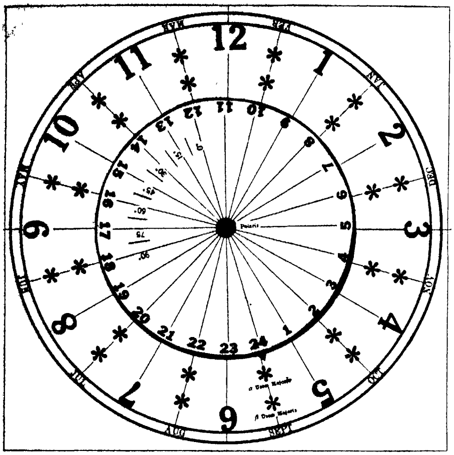


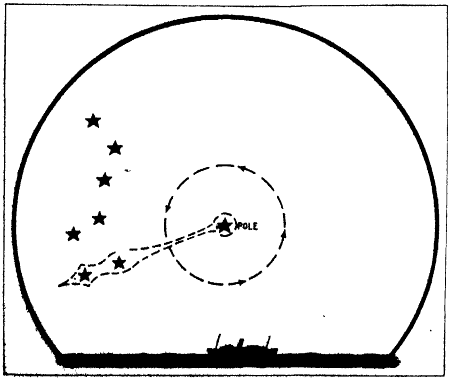
How to learn to tell time by the Big Dipper

A more serious predicament would confront this self-same navigator were he suddenly called in the night to abandon ship and take charge of a lifeboat Having now neither chart, almanac, nor sextant, his skill and previous knowledge of the movements of moon, planets, or stars would reveal nothing as to the whereabouts of the drifting lifeboat If this navigator were aware of a simple means to interpret the message as told by the clock in the sky he or anyone might be informed of their positions on this spherical earth of ours. There is a clock in the sky, visible on any clear night, or at times through a break in the clouds. It tells the time of the night from which is obtained the longitude, it informs of the true latitude.

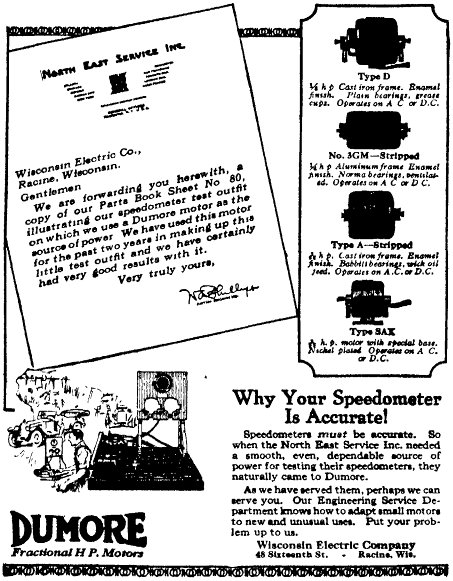
Everyone has gazed into the heavens at night and observed the Big Dipper with its ever-faithful Pointers indicating the position of the North Star or Polaris The hour hand of the sky clock is composed of this North Star and the two Pointers. The center of the revolving hand is the North Star. This hand moves counter-clockwise over the face of the sky clock at a rate of one-half that of the hour hand of an ordinary timepiece The hour mark of twelve on the sky dial is above, and the six-hour mark below, similar to any ordinary time clock On any night this hour hand can be read in the sky and the hour readily estimated; the hand is vertical at six and twelve hours, horizontal at the hour of three and nine The time we are noting in the heavens is star time, and we desire sun or watch time Therefore, the reading of the hand does not give directly the time of the night With a piece of cardboard, marked as illustrated, the difficulty is solved

The position of the clock hand in the sky is shown for the 22d day of each month at midnight or 24 hours Remember also that the clock hand continually moves counter clockwise about the North Star once in 24 hours. Take cardboard and plot the stars as shown in the illustration. Select another cardboard and divide into 24 hours Now cut in the form of a circle, first laying off in one quadrant 0° 15° 30°, and so on, to 90° showing angular arc 7½° apart. Bind the cards together at the

(Continued on page 61)



The Big Dipper's two "pointers" form the hands of a great clock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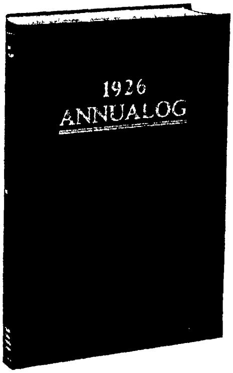

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center with a pin or thumbtack so that the inner wheel will revolve. The center pin is the Pole or North Star. On the date in which the latitude and longitude is sought set the 24 hour of the inner wheel on the Pointers of the month. Now read the hour hand of the clock in the sky

Suppose that on the night of September 22d our navigator in the drifting boat has his watch set to Greenwich time as is the usual custom. Let him note the hour in the sky, say seven o'clock. Set the inner wheel with 24 on Pointers at September, now follow the inner wheel to where the hour coincides with seven o'clock on the outer or sky dial and the time noted is 21 hours or 9·00 P.M. sun time or watch time of that date. Compare this time to the watch in pocket set to Greenwich time. Say, for illustration, the watch read 11:00 P.M. Then the difference between 9:00 P.M. and 11·00 P.M. is two hours. Since a difference of one hour in time is an arc of 15° of longitude, the longitude found here is 30° West. Applying the precepts of an old sea jingle which runs, "Greenwich time best, longitude west, Greenwich time least, longitude east," we really determine the proper hemisphere. Since in the above case the Greenwich time is best or greater, the longitude is west

Now for the latitude, look again for the clock in the sky This time look only at its center or North Star and bearing in mind the old elementary fact of astronomy that the latitude of any place is always equal to the altitude in the heavens of the North Star, set the degree mark on the horizon at 0°, sight at the North Star and read as closely as possible its altitude, say 37½° The navigator now knows he floats in about 37½° north 30° west.

He has determined a close approximation to the real truth of his whereabouts, much more so than would be possible by random conjecture Without tools, science is of no avail in our dilemma With the aid of a simple piece of cardboard and the clock in the sky the locality of the drifting boat is found. Perhaps some daring aviator blown far off his course by gales of wind and lost among the clouds may avail himself of what the clock in the sky tells

Elmer B Collins.

Where Credit is Due

Two very interesting letters have come to us as a result of our item on helium air in the July issue. We think our readers should be apprised of the facts concerning the origin of the idea that helium air would be useful for submarine divers It is our pleasure to present this information·

Dear Sir.

I notice in your Scientific American Digest, conducted by Mr Albert G Ingalls, on page 52 of your issue of July, 1925, that "helium air" for submarine divers is mentioned as a possibility, and the results of experiments made by the Bureau of Mines Scientific Corps confirm it.

It may be of interest to your readers for me to note that I made this suggestion more than five years ago, and attempted to secure from the Bureau of Mines a supply of helium for experimentation in this direction, but without success at that time. I communicated this idea to Prof. J C McLennan, of the University of Toronto, who had inquired of me suggestions as to possible uses for helium. My reasoning in the case has been shown to be correct by the experiments described. It is only proper that the public should be informed as to the origin of these ideas Copies of the letters concerning this matter are herewith transmitted.

Elihu Thomson.
Director of the Thomson Laboratory of
the General Electric Company

West Lynn, Mass., Aug. 25, 1919.
Bureau of Mines, Washington, D. C.
Dear Sir:

I am writing for information as to the actual status of the recovery of helium in quantity from natural gas. We have seen so many published statements in regard to this matter which were somewhat difficult to believe that I am appealing to headquarters for such information as may be available as I have in mind a possible use for helium by which experimentation would have to be carried out before settling its adaptability to the purpose I have in view

Very truly yours,
(Signed) Elihu Thomson

January 14, 1920
Mr. J. C McLennan, Prof of Physics,
University of Toronto, Canada
Dear Sir

I notice in the issue of *Chemical News*, December 19, 1919, under a note entitled "Helium" it is stated that you have been interested in finding uses for helium outside of balloon inflation. This prompts me to write you saying that I had communicated with our Bureau of Mines in relation to a use for helium based on the idea that after the war there would be a considerable stock of the gas on hand which could be obtained for distribution, if desired I found that this was not, indeed, the fact, and practically no pure helium (or nearly pure helium) had been produced from the Oklahoma or Texas gas as I had been given to understand had been done from the various publications My idea in relation to the matter is on account of its very high diffusive power, as compared with nitrogen, it might be possible to make a mixture of helium and oxygen to be supplied to divers or others working under high pressure, the amount of oxygen being determined by experiments, which when mixed with helium, should allow respiration and much greater freedom in the removal of effete gases from the lungs, the gas interchanged and speeded up from two to three times Only experiments could determine the value of this suggestion, if it has any; and, of course, it is based on being able to obtain helium fairly free from admixtures and in sufficient quantity to be supplied to a diver Inasmuch as salvage and caisson work is limited at present to perhaps about 150 feet or a little more, it is thought that by substituting helium for nitrogen in the air breathed this depth might be, say, increased 50 percent or more

Very truly yours,
(Signed) Elihu Thomson

Telescopes

Judging from the enthusiasm for telescope making, evidenced by the letters received in response to our November article, star gazing is going to be the pet pastime for hundreds of Scientific American readers Mr R F Wicker of Pinehurst, North Carolina, puts in his bid for more information on the subject, presents us with a bouquet, and then winds up with a threatening postscript

Editor, Scientific American

In your November issue you have an article dealing with the telescopes of home manufacture. By all means let us have the other article mentioned After whetting the appetite of your readers with the first article, I do not believe you are mean enough to withhold the second, even for a short while.

Years ago, there lived in the back woods of Cape Fear River a man famed in North and South Carolina as a millwright His schooling must have been meager, but it is told that he put to shame, by his superior natural wit, an expert sent out by the Leffel people to install a pair of wheels in a South Carolina cotton mill

People who knew him admired his ability and wondered where he got his knowledge

A few years ago (sometime after his death) the writer visited his home in search of some documents concerning the sojourn of the Scottish heroine Flora MacDonald, in the Cape Fear section, and upon opening his old chest of papers, brought to light a complete file of the Scientific American of Civil War vintage. I made no note of the dates, but recall one which explained the mechanism of the "New" Springfield rifle, with half page illustrations Of course, I understood immediately where he obtained his wisdom!

Very truly yours,
R. E Wicker, C. E.

P.S.—Don't delay that article!

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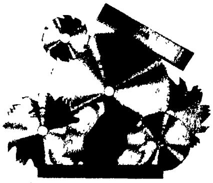

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"With Malice Toward None"

The Key-Note to the Final Lincoln

Review of the Army of the Potomac, 1865 (From Stephenson's "Lincoln")

"THE President was never in a firmer, more self-contained mood than on the last night of the session" (March 3, 1865). "He was in his room at the Capitol signing the last minute bills. Stanton was with him. On receiving a telegram from Grant, the Secretary handed it to the President Grant reported that Lee had proposed a conference for the purpose of a 'satisfactory adjustment of the present unhappy difficulties by means of a military convention.'

"Without asking for the Secretary's opinion, Lincoln wrote out a reply which he directed him to sign and despatch immediately

"'The President directs me to say that he wishes you to have no conference with General Lee, unless it be for the capitulation of General Lee's army, or on some minor or purely military matter. He instructs me to say that you are not to decide, discuss, or confer on any political questions, such questions the President holds in his own hands and will submit them to no military conferences or conventions Meanwhile, you are to press to the utmost your military advantages.'

"In the second inaugural delivered the next day, there is not the faintest shadow of anxiety. It breathes a lofty confidence as if his soul was gazing meditatively downward upon life, and upon his own work, from a secure height

"The world has shown a sound instinct in fixing upon one expression, 'with malice toward none, with charity for all,' as the key-note of the final Lincoln. These words form the opening line of that paragraph of unsurpassable prose in which the second inaugural culminates

"'*With malice toward none; with charity for all, with firmness in the right as God gives us to see the right, let us strive on to finish the work we are in, to bind up the nation's wounds, to care for him who shall have borne the battle, and for his widow and his orphan—to do all which may achieve and cherish a just and lasting peace among ourselves, and with all nations.*'"

—From STEPHENSON'S "LINCOLN."

"The Best American Biography Produced to Date"

When a great and discriminating book store such as Brentano's in New York City issues a notice like the following, you may be sure that it marks a notable event in the history of authorship and book publishing On a little card widely distributed by that house is printed: "We recommend LINCOLN, by Nathaniel Wright Stephenson, as one of the best American biographies of the last ten years"

And Professor Roy Franklin Nichols, of the Department of History at Columbia University, goes even further. He says "In my opinion, it is one of the best, or perhaps more accurately, the best American biography produced to date You are never in danger of forgetting that this is the story of Lincoln's inner as well as outer life When I closed the book I felt that I knew Lincoln I have never had the privilege before I believe that the publication of this book begins a new era of American biographical writing."

But Professor Nichols's estimate is only one item in a perfect avalanche of commendation from historical scholars of recognized authority, from prominent writers, from journals whose book notices carry great weight—and all of a favorable tone that is extraordinary.

"The most satisfactory life," says Professor Allen Johnson, of Yale, "Deserves unqualified praise," says the New York Herald Tribune, "Brilliant," says Senator Albert J Beveridge, "The most brilliant life of Lincoln ever written," says Joseph Lawton Newton, editor of the Christian Century, "Marvelous," says Frederick F Taylor, President of the Northern Baptist Convention (referring especially to Stephenson's analysis of the psychology of the great President), "A triumph of imaginative realism," says Stewart B. Sherman, "Fascinating," says the New York Times, "Superb," says Warren P Hall, Professor of History at Princeton University

The verdict is almost unanimous! Few books equal it in vivid interest and charm It is fascinating in its skillful delineation of the gradual development of Lincoln's mind and character and as an illuminating study in personality and springs of action.

In the face of such a wealth of laudation from such sources, it would seem to be a hopeless task here to construct another pæan of praise even with the highest skill in phrase making. This is a story of the development of a man's soul told with the consummate skill of an artist, carrying the reader along at a tension which, as the New York World says, "mounts and mounts into the crashing finale of victory—and the heroe's death"

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Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

In this photograph the speed governor is shown on the pilot wheel which is coupled with control circuits of the locomotive so that permissive speeds may be incorporated. Radio controlled signal lights on the cab forewarn the engineer of impending danger

Wired Wireless for Train Control

A WIRED wireless system of continuous train control by means of safety devices, operated by the high-frequency currents, has been demonstrated by the Pere Marquette Railroad. A locomotive traveling fifty miles an hour was stopped in the initial tests by applying brakes controlled by wired radio impulses. The system was invented by Thomas E Clark of the Tecla Electrical Laboratories.

The carrier current is sent into the rails of the track from a transmitter located along the route. Loop collector coils under the cowcatcher intercept the waves The apparatus sends a 28,000-meter wave to indicate the track is clear and a 22,000-meter wave to act as a caution signal The energy picked up by the coils actuate a visual signaling device in the engine cab If a red light flashes, it signifies danger, yellow caution, and green, a clear track ahead The red lamp is illuminated only when there is immediate danger of collision. If a train is occupying a block, the rail surface within that block becomes automatically demagnetized, and another train, entering from the rear or front, will have its red light flashed in the cab and the brakes are automatically applied.

Any tendency of the engineer to exceed the speed necessary in the "caution" zone results in a partial application of the brakes, so that when the locomotive enters the "danger" zone the brakes are automatically set.

Dellinger Gives Version of Fading

THE term "fading," may be incorrect according to Dr J. H. Dellinger, Chief of the Radio Laboratory, Bureau of Standards. In a broadcast Dr Dellinger said, "Fading simply refers to the fluctuations of intensity of signals received from distant stations. It is not likely to cause trouble if the station

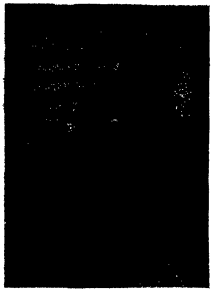
Wide World

This is the 60-kilowatt motor generator for supplying power to a large tube transmitter at station NAA, Annapolis, Maryland.

is within fifty miles, but from that distance up to 200 miles it is a genuine obstacle to satisfactory reception.

"In the daytime the radio waves go out from the transmitting aerial attached to, and sliding along the ground, just as an electric current comes into homes sliding along wires. The waves do not penetrate far up in the air, because of the presence of a sort of electrical screen or barrier produced by the action of sunlight on the atmosphere. At night this screen seems to disappear, allowing the waves to penetrate up into the rarefied upper atmosphere which is permanently in an electrically conducting condition. The waves apparently slide along this conducting layer, just as they slide along the earth's surface in the daytime, but there is a difference. In sliding over the land they are rapidly absorbed by trees, buildings and other obstacles, while along the upper atmosphere, at night, they are free from this absorption, and therefore, cover greater distances."

Dr. Dellinger explained that he believes this is the reason extremely low wavelengths travel further at night. "But this upper layer is not smooth," he continued, "it is rough and turbulent like a wave-tossed sea, and these variations give rise to the fluctuations of received signal intensity called, 'fading.'"



Kadel & Herbert

An interesting military radio exhibit at the electrical show in New York was this portable outfit designed for use by the cavalry. It is carried around on pack mules. It comprises a transmitter and receiver, each of which is effective at distances of from 60 to 200 miles

Rectifier Tubes Based on New Principle

A NEW rectifier tube designed for use in "B" battery eliminators has been developed by C. G. Smith of Cambridge, Massachusetts, and Dr Vannevar Bush, professor of electrical engineering at the Massachusetts Institute of Technology. It is a full wave rectifier and is known as the "Raytheon." The inventors claim that it is built upon a new principle, the forerunner of which is the "S" tube. The underlying principle is that any gaseous tube which has one very small electrode and one large electrode is a partial rectifier; that is, the current flows more readily when the larger electrode is made negative than when it is positive.

Scientists have been searching for years for insulators that would stand up under intense heat and would not break down under extremely high voltage stress or deteriorate with age. Mica, glass, lava and porcelain have all been tried, but without success. C. G. Smith, during years of development work on a gaseous rectifier, recently discovered that the insulator was the very gas with which he was working. It was found that this and other gases would not conduct current between two electrodes that were close together. The Raytheon was built with this "short-path" insulator as the foundation.

Among the advantages claimed for this

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Set shown is the table type.
Write for illustrated booklet of console models.

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With sets of 4 or more tubes, use either of the heavy duty batteries, No. 770 or the even longer-lived Eveready Layerbilt No. 486.

We have prepared for your individual use a new booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you upon request It also tells about the proper battery equipment for use with the new power tubes

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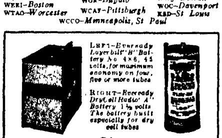

LEFT–*Eveready Layerbilt "B" Battery No 486, 45 volts, for maximum economy on four, five or more tubes*

RIGHT–*Eveready Dry Cell Radio "A" Battery 1½ volts The battery built especially for dry cell tubes*

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*Note In addition to the increased life which an Eveready "C" Battery gives to your "B" batteries, it will add a quality of reception unobtainable without it.

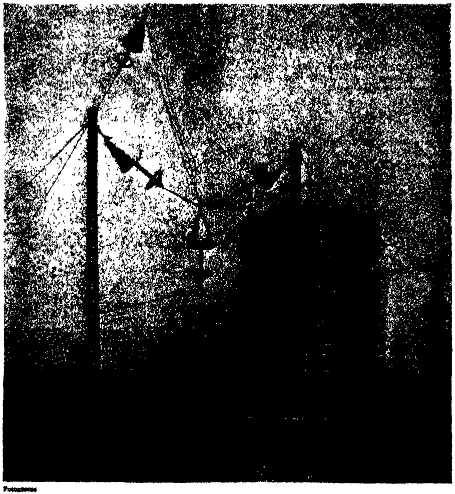
Wide World

A view of the aerial masts at Koenigswusterhausen, Berlin, the recently completed German radio station. It is designed for the transmission of commercial messages and for broadcasting. It can send twenty messages simultaneously

new tube are: no filament to burn out; high voltage output; high current output; excellent regulation, that is, the ability of the device to hold its output voltage at varying conditions of load or current drawn; full wave rectification and long life The tube can be made to deliver, at the output of the filter, potentials well over 150 volts, especially adapted for use with the new power amplifier tubes as well as with standard tubes. It is possible to obtain over 60 milliamperes without injury to the tube. Under continuous operation of an output of 50 milliamperes it is reported that there has been no sign of diminishing life in any stock tubes tested for 10,000 hours

The fact that there is no filament eliminates any necessity of attention during the service life of the tube. No rheostat is required and it is claimed that line surges will not affect the tube.

The gas employed is helium, at a pressure of about 12 millimeters of mercury. The tube depends upon ionization for its action and therefore the vacuum is not nearly as perfect as that used in common amplifying or detector tubes. It is necessary, however, to evacuate the bulb thoroughly before releasing the helium. Only a very small amount of helium is employed in the manufacture of these tubes and this is obtained in the production of liquid air. A quart of helium at atmospheric pressure is said to be sufficient for 700 tubes.



Fotograms

The high-power radio telephone station at Rugby, England, which is to be used for transmission to America, is ready for operation. The terminal will be connected shortly with the main London telephone exchange, and telephone subscribers then will be able to call New York. The charge for a three-minute conversation between London and New York will not exceed five dollars. The photograph shows the Rocky Point Station on Long Island

International Newsreel

A Britisher's radio vision machine consists of rapidly revolving disks which contain lenses and cause light to be thrown in succession on a cell which is sensitive to light. The varying strength of the light sets up a pulsating current, which is strong in the high lights and low at the half tones. The current is non-existent in darkness of night.

Chemists Improve Vacuum Tubes

As a result of a search by chemists over a period of one hundred years a new metal of immediate value and vast possibilities has been added to the world's technical resources in the form of pure metallic ductile thorium, which has been prepared for the first time by the Research Laboratories of the Westinghouse Lamp Company.

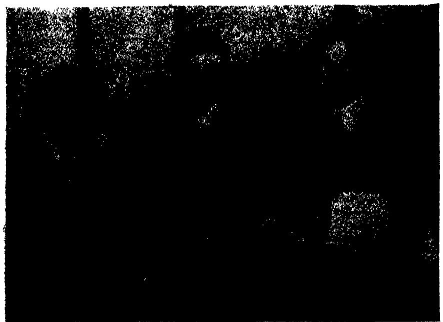
Thorium is of particular interest to radio enthusiasts because it is the active constituent of practically all vacuum tube filaments The present method of making radio tube filaments consists of compounding thorium oxide in the tungsten wire, because the thorium has the ability to throw off electrons with greater ease and at a very low temperature As the tube is heated the thorium oxide comes to the surface of the wire in the form of minute quantities of thorium metal, which gradually oxide off through the emission of electrons As the thorium on the surface of the tungsten is consumed, more of the thorium oxide within the filament comes to the surface, the service life of the tube ending when the thorium is all used up Through the use of the new method thorium can now be produced commercially in the filamentary form, as contrasted with the minute admixture with tungsten used at present.

In addition to its use in radio tubes, this metal is of extreme importance to the medical profession as a target material for X ray tubes, since the thorium is much more efficient than tungsten

The new metal has been produced by Dr H C Rentschler and Dr. J W Marden It has a purity greater than commercial aluminum It has the second highest atomic weight of any of the known elements and a hardness about the same as that of soft iron, but is nearly 50 percent heavier It has a melting point higher than platinum, is easily machined and can be worked cold It can be made in any shape.

The preparation of thorium in powdered form was first attempted in 1829, and since that time dozens of experiments have been recorded, none of which succeeded in producing a powder suitable for making a ductile metal The Westinghouse engineers found that they had to devise methods for making chemically pure various ingredients to be used in producing thorium and it was also necessary to develop a special type of furnace and a suitable crucible for heat treating the thorium in a new manner

The full value of metallic ductile thorium can only be determined in time, just as in the case of tungsten, which some thirty years ago was regarded as a useless curi



International Newsreel

Our photograph shows Mr. Marconi holding his first transmitter. At the left is Mr. G. S. Kemp, the inventor's chief assistant. Mr. Kemp was with Marconi in Newfoundland on December 12, 1901, when he detected the first transatlantic wireless message, broadcast from the 50-kilowatt spark station at Poldhu, on the southwest tip of England. Viscount Wolmer is in the center

How I Earn $100⁰⁰ a Week as a Radio Expert

A year ago I was mighty blue and discouraged It seemed to me that I would never be more than a low-paid bank clerk Of course I had a small increase in salary every now and then, but I knew that pretty soon I would reach my limit and there would be no further advancement for me. What future had I to look forward to? Where would I be in five years? I became restless and discouraged and began to look around for some other opportunity

It was then that I discovered that the demand is for *trained* men, that the opportunities are all for men who can do some one thing better than anything else There were wonderful opportunities for men who were experts or specialists—but I was—a clerk How I regretted then that I hadn't prepared myself for some definite career!

I Wanted to Marry

The thing that made me more restless at that time than anything else was the fact that Marian and I were—that is, we wanted to be married But we both knew that we couldn't possibly get along on my small salary If only there was something I could do that would bring me a larger salary!

It was just about the time that everyone became so interested in radio Our whole town became radio-mad, and of course what was happening in our town was happening all over the country—all over the world I managed to save up enough to buy a receiving set and I was never quite so happy as when I was trying to tune in on stations

The thing fascinated me Playing with air waves! Bringing melodies and messages out of the sky! I was never so interested in anything before

Marian was the first to sense the great opportunity. "Why don't you become a radio expert?" she said. "You like it and I am sure there must be a big demand for men who understand it It's a new field and there's plenty of room for wide-awake men"

"But—but I'm not trained!" The thought excited me. To be a radio expert! To find my future in this fascinating new field! "I don't know anything about it, Marian," I said, "I wish I did, though"

"Well, why don't you find out about it," she retorted "You can't learn about radio just by listening in to the concerts Why don't you take a course?"

But we found out that most courses were expensive or that they would interfere with my other work We were about discouraged when I discovered that through the National Radio Institute it is possible to become a radio expert by studying right at home in spare time I told Marian about it and she was elated "Send off for information, at once—today!" she exclaimed

Advances Quickly to $100 a Week

I did, and the following day received an important booklet, "Rich Rewards in Radio," telling all about radio opportunities and how to become an expert in any particular phase of the work

Here was my opportunity at last!

I began to study in all my spare time. It was the most interesting and absorbing study I had ever made The secret of the radio revealed to me! Day by day I became more skilled and deft until I was able to take apart receiving sets and put them together again as though I were playing with a toy It was fun! In a month I was able to take a position as lineman at a bigger salary than I was getting at the bank This was wonderful experience for me and I kept right on with my studies It wasn't long before I qualified for a position as radio engineer at a salary of $100 00 a week! That is what I am earning now, though I expect to make more soon It seems to me almost too good to be true, after all those years as a low-paid clerk in a bank And Marian, who will soon be my bride, keeps saying, "I told you so!"

As a radio expert I can tell you that there is a tremendous demand for men who can build, sell and install radio sets, who can design, test, repair Men are needed as engineers and executives, all over the world The opportunities are limitless and if you like radio there is no reason why you cannot qualify for one of these positions by studying in your spare time at home as I did

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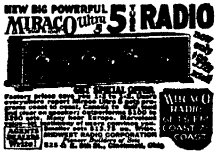
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ACHIEVEMENT, for some of the greatest human works have been—and will be—accomplished in Asia.

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VISION, for the greatest leaders of the West—Napoleon, Roosevelt, John Hay—have seen Asia as deciding the future of mankind.

NATURE, for the majestic animals of the East, tigers, elephants—are always in its pages.

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Contents of January ASIA

"MONGOLS" OF TWENTY THOUSAND YEARS AGO—Roy Chapman Andrews, intrepid leader of the famous expedition of the American Museum and ASIA Magazine, which is hunting in Mongolia for the earliest man, tells of his most astounding find of a hitherto unknown race of people—Mr. Andrews' first personal story of this great discovery.

REINDEER IMMIGRANTS—How the white man may continue to eat meat despite the fast disappearance of cattle and sheep herds, is told in a fascinating romance of pioneering by the famous Lomen family who have turned thousands of square miles of useless Arctic moss into a producing ground for a new world meat supply.

THE HIDDEN KINGDOM OF THE HOUSETOPS—When the air is heavy with the fullness of summer on the housetops of Tunisia the hidden Arab women come together on the roofs to gossip—like all prisoners, *signalling with a secret code from house to house and street to street.*

TROUBLE BEHIND THE TROUBLE IN CHINA—The sharp conflict of interests between Japan and Russia in Manchuria and Mongolia was not settled by the Russo-Japanese war. Profoundly significant moves on the inner checkerboard of world conflict over the Far East are laid bare in this article.

"THE MOST RESPECTABLE ANIMAL IN THE WORLD"—So says a handbill of 1797 of the first elephant brought to America from Asia in 1796. "By his intelligence he makes as near an approach to man as matter can approach spirit." A quaint tale of old times.

COMMUNISM versus CHRISTIANITY—Are the teachings of Christ regarding property far different from Communism? How do the two differ? Is the Orient to be the battleground of the two? Startling questions that every Christian will have to answer in his personal life.

INDIGO DAYS IN INDIA—A young Englishman tells how he abandoned the time honored policy of the white man of "cursing and kicking" the native Indian laborer—and the result. A personal experiment in solving the conflict of two great races.

WESTERN "BARBARIANS" IN JAPAN—The prodigious noses of the first Westerners in Japan nearly three hundred years ago struck the funny vein of the Japanese. But the islanders received the first European Christian missionaries with a warm welcome. Why was it that later the Japanese massacred them and sealed up Japan against all foreigners until Commodore Perry arrived?

MIGHTY RESTING PLACES OF ASIA'S MIGHTIEST—America can see and profit by the beauty and dignity of the Orient as mirrored in the great works of art the East built to commemorate its greatest men and women.

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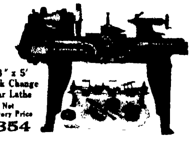

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Kadel & Herbert

The builder of this broadcaster claims to have produced waves one meter in length. Note the simplicity of the short wave equipment. Yet amateurs are able to talk across the seas with less power than is required to operate an ordinary electric flatiron

osity, but today is the basis of practically all electric lamps, X-ray tubes, high-speed metal-cutting tools and many other similar applications of great commercial value.

A Visual Radio Indicator for Air Pilots

A NEW type of radio beacon tower is to be built at Monmouth, Illinois, as a guide for the Air Mail Service. The new arrangement is based upon an old interlocking signal system. A pilot endeavoring to maintain his course in the direction of the beacon hears a definite signal. If the plane goes to the right or left of the course the signal sounds like the Morse "N" or "A" respectively. While the plane is on the correct course, the two *interlocking* signals are of the same intensity and a third signal is formed such as the Morse "T" which is a continuous sound. This unbroken sound indicates to the pilot that he is on the right course. If he hears the "A" or "N" signal it is a warning that the plane is to the right or left of the main route. Then he resets the nose of the plane until the constant signal is picked up.

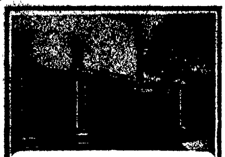
The difficulty with this system has been that the aviator is entirely dependent upon hearing, and that is often unreliable when the airplane engine and propeller are in action. This has been *corrected* by a visual indicator. It consists of three small lights, mounted on the instrument board and wired to the radio receiver. The constant signal created by the interlocking of the two signals at a point of equal intensity causes a relay to operate a telephone selector, which in turn causes a white light to flash. This *light tells the flyer he is on the course.* To either side of the route, the component signals actuate relays, which in turn cause the selector to close the circuit, lighting a green or red lamp, one of which indicates the plane is to the right of the course and the other, that it is flying to the left. The visual indicator system is a much safer guide for the pilot than was the old signal system.

Latest Dial Spaces Low-wave Stations

OPERATORS of receiving sets equipped with ordinary variable condensers often find it difficult to separate broadcasting stations in the lower wavelength band, and this has forced manufacturers to develop a new type of condenser with such characteristics that at the lower readings the variation in capacity is small. Such a device is known as a straight-line frequency condenser. There are so many existing sets equipped with the old type of condenser that several manufacturers have introduced what they call a "straight-line frequency dial" or "con-

Kadel & Herbert

Here is shown the complete radio equipment taken from a Martin bomber. On the left is the transmitter, which covers wave lengths of from 850 to 1,800 meters. Next to it is an audio amplifier which uses "peanut" tubes, and next is the receiver which covers a wave band of from 500 to 1,300 meters



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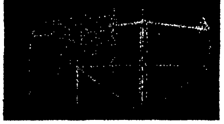

A Pocket 66" Slide Rule

HOW would you like to own a slide rule 66" long? Here is its equivalent in pocket form.

The Otis King Patent Calculator has open spiral scales 66" long, marked on two metal tubes; and yet when closed, it only measures 6 inches.

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verter," which spaces the broadcasters evenly across the dial scale.

The converter is in the form of a dial, generally about four inches in diameter, and it can be mounted either by drilling the panel or by gluing it to the panel with four fibre disks which are provided. The only change necessary is to remove the old dial and replace it with one of the new type, which has the added advantage of using the full 360 degrees of the dial, giving double separation between stations and preventing crowding, especially on wavelengths below 300 meters.

New Amplifiers Give More Volume

SEVERAL letters have been received regarding the use of the new UX-120 amplifying tube, and there seems to be some question as to the sets in which this new tube can be employed.

The UX 120 is a dry battery amplifier tube, suitable for use only in the last stage of an audio-amplifier circuit It can be used in any set equipped with an audio-amplifier unit, and this includes the super-heterodyne and neutrodyne receivers. The purpose of the tube is to greatly increase the volume and improve the quality of reproduction from dry battery operated sets A special socket adapter, known as the UR-556 is required. The plate potential should be 135 volts. A "C" battery of 22½ volts is needed. The proper battery connections are marked on the adapter

The UX-112 is designed for use in the last audio stage of storage battery sets It operates from a six-volt filament source The plate potential should be 135 volts, with a negative grid bias of nine volts

Canadians War Against Regenerative Howls

THE radio division of the Canadian Department of Marine and Fisheries has issued a circular relative to the correct operation of a regenerative set so that it will not produce howls and squeals in neighbors' receivers. It is estimated that 50 percent of the "preventable interference" is caused by incorrect operation of regenerative circuits The Canadian authorities are striving to clear the air of regenerative whistles

The principle of regeneration, as used in radio sets, is that a part of the output of the detector vacuum tube feeds back into its own input and thus greatly increases the volume of the signal

The Hertzian waves, intercepted by the antenna, travel down the lead-in through the primary coil of the tuner and so to the earth down the ground wire The weak electric current resulting from this influences the detector tube in such a way as to start it functioning The resulting output from the plate circuit of this tube is fed back in such a manner as to create a "field" or influence in the part of the circuit connected to the input, or grid circuit. This "field" induces in the grid circuit a current of electricity of the same frequency as that of the received Hertzian waves. The energy, therefore, which comes down the antenna lead in is automatically strengthened by an impulse from the output of the detector.

Unless properly controlled this action will continue until the saturation point is reached, when the tube is said to be in a state of oscillation. When a receiving circuit is in oscillation it causes howling in the set and in neighboring sets, because it acts as a miniature transmitter Therefore, regeneration should never be allowed to proceed to the climax, as it then becomes a public menace.

Furthermore, when a receiver is in the state of oscillation, it causes whistles in all types of receiving sets which are tuned to the same station; it distorts the quality of the music or voice; it uses more "B" battery and therefore, reduces the life of the "B" battery; it tends to reduce the life of the detector tube.

It is easy to tell if a set is disturbing the neighbors Leave the regeneration control in a fixed position, slowly rotate the tuning dial and note the change in the sound of the whistle If the whistle rises and lowers in pitch sympathetically with the movement of the tuning dial it is an indication that the set is oscillating

Panels Decorated in a Novel Way

VERI CHROME is a new process for decorating radio set panels In the past it has been the practice to put the markings on the panel with an engraving machine It required skilled workmen and the machines were costly Furthermore, satisfactory work could not be done at night. The Veri Chrome method puts the decoration on rapidly in large quantities, as is the case with *lithographing or printing* It costs less than engraving and the volume of production is increased. The amount of decoration put on the panel makes no difference in cost, but with the engraving method each additional line and character adds to the cost. The most elaborate painting or design covering every inch of the panel can be put on with no greater cost than the simple characters and tuning directions that are usually engraved on panels With engraving the decoration is confined to white lines but with Veri Chrome, gold, silver or any other color can be used Another source of economy where Veri Chrome panels are used is the fact that the tuning scales can be marked directly on the panel instead of on dials. This allows a knob and pointer to do the work of the more costly dial.

Radio Sets on Farms

A QUESTIONNAIRE circulated by the Department of Agriculture disclosed that only eight and one half percent of the farms in the United States are equipped with radio receivers In 1924 it was calculated that 364,800 farms owned radio sets and in 1925 the figure grew to 553,003 It was estimated that 26,134 farmers in New York State had radio sets in 1924 and in the fall of 1925 the estimate was 38,750.

Automatic Device Puts Battery on Charge

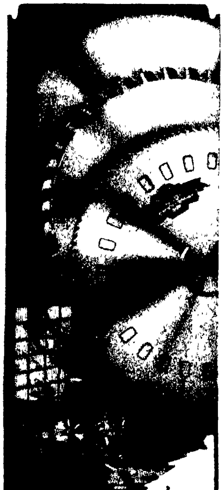
A NEW device, known as a "Regostat," when interposed between the "A" battery and the battery charger, automatically connects and disconnects the charging system thereby keeping the battery in a charged condition at all times. When the voltage of the battery drops below the point where further discharge is inefficient and detrimental to the plates, an armature drops, closing a circuit which places the battery on charge

Ships Asked to Stop Code Interference

THE Department of Commerce has signified its willingness to enter into reciprocal relationship with the British and Canadian authorities to prohibit vessels of the countries named from using wavelengths of 300 to 450 meters when within 250 miles of the United States, Canada or the British Isles Instructions have been sent by the Department of Commerce to radio supervisors, asking that all operators of United States ships be advised to discontinue the use of the wavelengths named when within the specified distance of the coasts.

Largest Carillon on the Air

THE largest carillon of fifty three bells, the gift of John D Rockefeller, Jr, to the Park Avenue Baptist Church, New York, are broadcast by WJZ Forty five of the bells actually hang in the tower, but the eight largest bells are lower down where there is a firm foundation The combined weight of the bells is over 50 tons It is stipulated that each broadcast will conclude with either "America" or the "Star Spangled Banner"



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The Book Department

Owing to the numerous requests we are receiving for books on ASTRONOMY, the following are suggested as taking the subject from the standpoint of an amateur, or those without technical equipment, to the more advanced stages of the subject

Curiosities of the Sky by Serviss $3.15

In the sky the layman has seen curious bodies, constellations, stars, comets, meteors, lights and has often asked himself what it is all about This book tells him, and puts him on the road to a more intimate knowledge of that fascinating science, Astronomy

Beginner's Star-book by McKready 5.15

Those who are without technical equipment will appreciate the Author's effort *to assist them in claiming through the unaided eyes, or through simple optical* instruments, their heritage in the things of the sky

Why the Weather by Brooks 2.15

A popularly written treatise on that most interesting and talked of subject, the weather. The Author attempts to illustrate the many phases of weather science and to emphasize their fundamental laws.

General Astronomy by Jones 6.20

Mathematics have been almost entirely excluded in order that the volume may appeal to the amateur, no less than the student Considerable trouble has been taken to procure a representative series of astronomical photographs.

General Astronomy by Young 4 15

Designed as a text book of astronomy suited to the general course in our colleges and schools of science, and meant to supply that amount of information upon the subject which may fairly be expected of every "Liberally educated" person

Modern Astrophysics by Dingle 8 65

A book which has long been needed. Thoroughly covers the newer developments of astronomy based on the great advances of the 20th century. As non-technical as it is possible to make this somewhat advanced subject, and especially valuable to those who regularly follow Professor Russell's monthly articles in the Scientific American

John A. Brashear (an autobiography) by Scaife 4.15

The autobiography of "Uncle John" Brashear, as he was known to thousands, is above all, romantic The boy with a love for the stars, who surmounted every obstacle until he became a leader in the making of astronomical lenses and instruments of precision, here tells the story of his heroic struggles A fitting climax to the student of astronomy See review in December Scientific American

All prices postpaid

Useful Aspects of Geology

By S. J. Shand

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Univ of Stellenbosch, S Africa

For the man who has never picked up any systematic knowledge along this line, here is an account of the various ways in which knowledge of geology can be turned to use and where to obtain the same. Published by D Van Nostrand Co. $2 65 postpaid

A Text-book of Physics

By L. B. Spinney

Prof of Physics, Iowa Univ

A complete reference especially strong on Electricity and Magnetism along the lines of recent development The Third Edition Published by The Macmillan Co $3 95 postpaid

Niagara in Politics

By J. Mavor

Prof Emeritus of Political Economy,
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By M. Klar-A. Rule

The increased interest in fuel substitutes makes this authoritative and complete work most timely It is precise and determinative, yet readily understood Published by D Van Nostrand Co. $6 70 postpaid.

Animals of Land and Sea

By Austin Clark

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Reveals the relationship between human life and the animals which are necessary thereto or are the enemies thereof The author's distinction as a research investigator lends authority, while his style gives fascination to the subject Published by D. Van Nostrand Co. $3 20 postpaid

Clockmaking

By G. F. C. Gordon

The author covers ground which either has not been trodden before or expands details which experience indicates should be amplified It presupposes acquaintance with Britten's books on fundamentals Published by N W Henley Pub Co $5.20 postpaid

Modern Business English

By A. C. Babenroth

Asst Prof of English, Columbia

A practical manual of advanced methods of using words to develop business The experience and results from the most progressive business houses Published by Prentice Hall, Inc $4 20 postpaid.

Science as Revelation

By J. M. Watson

To counteract the cry that science leads away from religion, the author long under religious instruction, depicts how the truths of nature constitute a dependable revelation by which he has acquired "a newer, higher and holier view of religious belief" Published by The Macmillan Co $2 40 postpaid.

[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]

Science and Money

Rayon

By Henry C. Trundle

THROUGH rayon (the official name for artificial silk) common folks again enjoy the splendor of kings. The very royal purples themselves are made abundant and cheap and the demand is such that a myriad of manufacturing concerns have sprung up, both here and abroad.

Rayon was invented about forty years ago by a Frenchman, the Count de Chardonnet, who discovered that the nitrocellulose obtained by treating cotton linters with nitric acid could be made into a lustrous fibre by pressing it through small dies into a coagulating solution Other processes have since been discovered—the so-called Viscose process now being used, while the new Acetate process is gaining in importance

Since about 80 percent of the total rayon produced is manufactured by the Viscose process, it will be of interest to have present information regarding it

Sheets of spruce wood pulp are first steeped in caustic soda of 15 to 18 percent, then pressed, crumbled, and exposed to air for a day or two The resultant alkali cellulose is treated with carbon bisulphide, and forms cellulose xanthate, which is dissolved in alkali, allowed to "ripen," filtered, and sent through the jets into the coagulating liquor.

While artificial silk may seem to be a very new product its first commercial development was attempted in 1894, although manufacture was not successful until 1910, nor important until 1912 Its greatest progress has been in most recent years, due in part to enlarged markets, such as are enjoyed by motors, radios, and so on.

Rayon Contributes to Textile Industry

Rayon does not have the same chemical analysis as silk, nor is it claimed to be an imitation silk. The entrance of this new fibre into the textile field has been of great aid in the revival of the textile industry. Styles have changed from heavy, plain cottons and woolens to the lighter colored fabrics Alone and in combination rayon has met these changes, and even led in a further exploitation of its uses. It is said that there is no branch of the textile industry, the future of which appears more promising than the artificial silk trade. America now leads in the production of rayon and it will undoubtedly be to the artificial silk world what Japan is to the natural silk market.

At first rayon was used principally for knitted outerwear, underwear and stockings. Now rayon—cotton mixtures, draperies and upholsteries have opened up extensive markets. Further uses are in electrical insulation, tire fabrics, and as a substitute for rubberized silk. It has been found adaptable to the many uses of silk at less than one third the cost

Is this substitution of rayon for silk causing a fall-off in production of natural worm silk? Quite the contrary is the case as the following comparative tables will show. Figures are in pounds:

	Rayon Consumption	*Raw Silk Consumption*
1925	58,000,000	*33,174,000
1924.. .	40,562,000	51,281,000
1923. ...	39,287,000	49,506,000
1922	26,494,000	50,711,000
1921 . ..	18,667,000	45,355,000
1920.. ..	9,847,000	30,058,000
1919. ...	9,149,000	44,817,000
1913.. ..	3,871,000	27,979,000

**For 7 months ended July 31.*

The increased rayon production is indeed notable, especially in view of the large raw silk production. Because it so excellently combines with other fabrics to make modish materials, the demand for it is strengthened as new creations are desired in style changes

Companies engaged in the manufacture of rayon have not been wont to give out statements as to production costs, profits, and similar statistical data. The largest producers are concerns such as du Pont, which have developed rayon as a sort of a side line, merging any profits with those from other corporate activities. A reading of a balance sheet or earnings statement, therefore, discloses nothing to the person interested solely in the rayon branch. Either this situation is present, or we have the foreign concerns, which have adopted a policy of strict secrecy regarding derivation of income. The officials of the American subsidiaries of these, however, are more liberal and are at least issuing part statements As additional capital is needed for plant construction and other extensions, more complete financial statements will be available to the public.

Future Expansion Hinted

Offerings of stock in rayon companies have recently come upon the market in number. In some cases it is just the distribution in the United States of shares in European companies, well established and formerly known as successful money makers This popularization in our country of these foreign industrial shares may be by way of preparing for further financing to meet future expansion requirements. Such sale of stock also has the tending to make the product rayon better known, since it will thus be the study of investors, merchantmen and others, as well as of the actual buyers and users.

Other companies which are offering stock (and of which we may expect a superabundance) are comparative newcomers in the field, and their financial statements will for the most part be estimates of expected profits rather than the publishing of actual results Capitalists, large and small, will seek to form companies, with successful manufacturers in other lines as the heads, to go after the large profits that are apparently to be had

New stocks that have been placed on the market and traded in have gyrated grandly in price Original offerings have been at about $20 to $25, and have later been run up to $50 to $70, with subsequent reactions of 20 to 25 points. If we can believe that the underwriting bankers priced these stocks correctly at the time of issue, it is hard to understand that business has increased so much in the intervening period of only a few months to justify such a rapid and high appreciation in market price. It may develop that such is the case, although it now appears that the future has been considerably discounted, with just a touch of market sentiment and speculative ambition thrown in.

Purchasers of rayon company stocks will safeguard their interests in a large measure if they are careful in the selection of the bankers through which they may deal.

Despite increased production facilities, manufacturers of rayon have had their output contracted for months in advance. This fact is most encouraging and portends well. For the year 1926 the American production is estimated to approximate 75,000,000 pounds, 80 percent of which is expected to be manufactured by two leaders in the field. The prevailing opinion is that while supply may more nearly approximate demand than this year there is little danger of over-production with a subsequent accumulation of stocks to be carried over into 1927.

One important factor which will assure a rapid expansion in the rayon industry is that prices have been stable. Manufacturers have held to this policy rigorously and it has contributed much to the proper development and stabilization of the industry. Raw silk prices have changed continuously during the year and users have found it necessary to watch the original markets closely. Trade reports have constantly given out warnings of further price advances, of lessened supply, and have urged that commitments be "hedged." This situation is annoying to manufacturers, and they welcome a stabilized price for rayon. The effect on the rayon trade is obvious, especially since production is limited only by plant capacity.

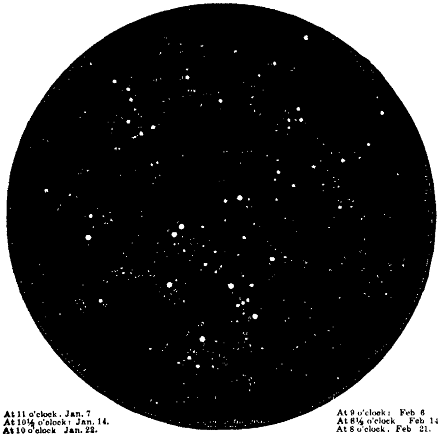
Not all companies with the word "rayon" in their corporate names are or will be manufacturers of the fibre. Some of these limit their business to the manufacture of fabrics using rayon in its structure Discerning investors may prefer to associate themselves with this type of manufacturer rather than with the maker of rayon itself, in the belief that over a period of years there may be greater stabilization.

Investors want to have the opportunity to share in the profits from this new industry. They will have this privilege. The question for them to decide is into which companies they care to buy a partnership It is interesting to note that in the past earnings were published at the time of security offering, but afterward the shareholder could guess his own figures and the stocks drifted along for themselves. One such stock declined to a very low figure shortly after the offering, despite the published earnings of $30 per share A recent quotation was above $200—indicative of a better appreciation of the industry and of the ability of this particular company. Since there is now a better understanding of the industry, such an occurrence may not again happen.

With proper selection, the public should make money along with the rayon companies. Sound economic factors are present. Demand is growing with widening markets Stable prices and controlled supply, in contrast to the fluctuating prices and undeterminable supply of natural silk are all in favor of rayon

The Heavens in January

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock. Jan. 7
At 10½ o'clock: Jan. 14.
At 10 o'clock Jan. 22.

At 9 o'clock: Feb 6
At 8½ o'clock Feb 14
At 8 o'clock. Feb 21.

At 9½ o'clock Jan 29

NIGHT SKY: DECEMBER AND JANUARY

The Heavens

THE winter constellations are now at their finest. Orion is due south, with Aldebaran above, on the right, and Sirius below on the left. Far down on the horizon, dwellers in latitudes south of thirty-five degrees may catch a glimpse of Canopus—the second in brightness of all the stars—a little to the right of Sirius. Gemini and Auriga are almost overhead and Canis Minor high in the southeast. Leo is the principal constellation in the east, and Ursa Major in the northeast. Draco and Ursa Minor are in the north, Perseus, Andromeda, and Cassiopeia in the northwest, and Cetus and Eridanus in the southwest.

The Planets

Mercury is a morning star this month but is far south and poorly placed. He rises about 5:45 A.M. on the first, and may be visible in the early part of the month.

Venus is an evening star, and at her brightest, excelling Sirius thirteen-fold in light. She sets at 8:00 P.M. on the first, and is very conspicuous. Later in the month she draws in rapidly between us and the sun, and by its end she is lost in his rays. Telescopically, and even with a good field glass she may be seen as a fine crescent

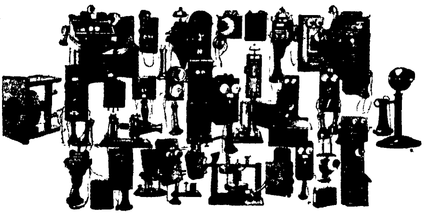
Mars is a morning star in Ophiuchus, and rises about 4:00 A.M. in the middle of the month.

Jupiter is at first an evening star, although too near the sun to be seen On the twenty fifth he is in conjunction with the sun, and becomes a morning star

Saturn is a morning star in Libra and rises about 3:00 A.M. Uranus is in Pisces and observable in the evening; Neptune is in Leo and is visible almost all night.

The moon is in her last quarter at 2:00 A.M. on the seventh, new at 2:00 A.M. on the fourteenth, during the eclipse, in her first quarter at 6:00 P.M. on the twentieth, and full at 5:00 P.M. on the twenty-eighth She is nearest the sun on the fourteenth and remotest on the second and twenty-ninth

During the month she passes near Neptune on the second, Saturn on the ninth, Mars on the eleventh, Mercury on the twelfth, Jupiter on the fourteenth, Venus on the sixteenth, and Uranus on the seventeenth. None of the observable conjunctions are close.



An Account of Stewardship

FIFTY years ago Dr. Alexander Graham Bell was busy upon a new invention—the telephone. The first sentence had not been heard; the patent had not been filed; the demonstration of the telephone at the Centennial Exposition had not been made. All these noteworthy events were to occur later in the year 1876. But already, at the beginning of the year, the basic principle of the new art had been discovered and Bell's experiments were approaching a successful issue.

The inventor of the telephone lived to see the telephone in daily use by millions all over the world and to see thousands of developments from his original discovery.

If he had lived to this semi-centennial year, he would have seen over 16,000,000 telephones linked by 40,000,000 miles of wire spanning the American continent and bringing the whole nation within intimate talking distance. He would have seen in the Bell System, which bears his name, perhaps the largest industrial organization in the world with nearly $3,000,000,000 worth of public-serving property, owned chiefly by an army of customers and employees.

He would have seen developed from the product of his brain a new art, binding together the thoughts and actions of a nation for the welfare of all the people.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
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BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Process Engraving

WHAT constitutes engraving and what does not is discussed at length by the Federal Trade Commission in its decision, finding the Process Engraving Company guilty of so misnaming its product as to constitute an unfair method of competition.

"In producing engraved products for commercial purposes, characters or drawings are engraved upon copper or steel plates or dies in intaglio, the depression filled with ink, surplus ink removed from the surface of the plate, and the sheet taking the impression brought into contact with the plate under pressure in special presses in a process known as 'plate printing,'" says the Commission "Thus has been produced the work known commercially as engraving, using the term without qualification"

The respondent produces an imitation engraving which has become popular in recent years which it calls process engraving This is the result of the use of a chemical in powdered form which is applied to type printing while the ink is still wet, this chemical adheres to the wet ink and in passing through a baking process the heat causes it to fuse and present a raised letter effect so as to resemble in appearance the impression made from engraved plates.

Such products, the Commission finds, "do not resist temperature changes or handling so well as matter printed from engraved plates, nor so well as plain flat printing, but its simulation of true engraving in effects produced, makes it more attractive to customers than plain, flat printing, and it has the advantage of being less expensive than true engraving"

Henry Ford on Patents

HENRY FORD recently had this to say about patents

"Patents are silly things when they are used to hinder any industry No man has a right to perfect a patent for profit only That produces parasites, men who are willing to lie back on their oars and do nothing If any reward is due a man whose brain has produced something new and good, he should get it through profits from the manufacture and sale of the thing

"We take patents on our own developments and discoveries only to prevent others from freezing us out when they may have a chance to make the same discoveries We use patents to prevent a shut-out game We believe in the gospel of use"

Mr Ford comes pretty close to agreeing with the Constitution which gives Congress power "*to promote the progress of science and of the useful arts* by securing for limited times to inventors exclusive right to their respective writings and discoveries"

When Do Inventors Invent?

THE autumn tide of inventions is now at the flood Next month it will begin to recede, until, in December, it reaches the lowest ebb of the year Then it will swell again until March, when it will attain its high mark Then it will ebb again as summer draws near

Every year as regular as the ocean tides, the tide of inventions ebbs and flows In the early spring the greatest number of inventors seek patent attorneys and in the summer months the least Many explanations have been offered as to just why this is so Perhaps the real explanation is something like this

In the winter months the farmer, with time hanging heavy on his hands, has been tinkering away with an idea he has for doing something in a better way, and the man in the shop, as the wheels speed up, sees more clearly the need of some new device or process By early spring they have each perfected their invention and are ready to seek patent protection. Then, as summer draws on and the mechanic looks forward to playing outdoors and the farmer to working from dawn to dusk, there is less time for inventions. Some use the vacation season to work out new ideas; the rise in the number of applications in the fall shows that.

But how about the drop in December, all by itself, you ask. Why, that's the month Christmas comes in and every inventor must use all his resources—mental resources, of course—to help Santa Claus.

Wide World

Jean A. LeRoy's invention of the motion picture is said to have made the development of the huge film industry possible. He might have been rich today; but he did not take out a patent

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60 Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Electrical Devices

RADIO STATION INDICATOR—Which can be readily applied to any panel-board and connected to the shaft of a turning element Patent 1555743 E G Ballenger, 805 Henley Bldg, Atlanta, Ga

COIN DETECTOR—In the form of a coin-responsive electric system, operable only on receipt of a genuine and unadulterated coin. Patent 1555910 F R Chester, 1416 Broadway, New York, N Y.

ELECTRIC LIGHT UNIT—For use in connection with the standard outlet, which can be easily installed, and securely attached without wood screws Patent 1557515. F E Wooley, 66 Central Ave, Manasquan, N J

BURGLAR ALARM—That may be associated with any telephone set without attaching any parts of the alarm to the telephone set Patent 1557373 A D Sindt, 240 W. 108th St, New York, N Y

COMBINED TELEGRAPH RELAY AND TELEPHONE—Having a telephone and telegraph key combined therein, so that either may be employed in transmitting over a single wire. Patent 1557247 W R Garner, 123 W. 61st St, New York, N Y

ELECTRICAL DISPLAY APPLIANCE—Which may be used to attract attention to any particular exhibition or display in a store window Patent 1557430 L R. Crow, 672 E Locust St, Vincennes, Ind

LINE TESTING APPARATUS—Equally well adapted for testing metallic or grounded circuits, is compact, convenient to carry and safe and reliable in operation. Patent 1558,211 C D Williams, Silver Lake, Kan.

PROCESS OF MAKING DRY BATTERIES.—Whereby a paste may be made without the usual cooking apparatus, and the expenditure of heat Patent 1558413 B. H. Teitelbaum, c/o Bright Star Battery Co., Terminal Bldg, Hoboken, N. J.

ELECTROCENTRIFUGAL SEPARATOR.—Which involves the separation of suspensions or emulsions by simultaneously employing the action of an electric field and centrifugal force. Patent 1558382. A. Marx, 162 Boulevard Voltaire, Paris, France.

Of General Interest

REFRIGERATOR—So constructed that a large number of articles may be cooled, and selectively removed without disturbing any of the other articles Patent 1551879. R. O. Hoffman, Box 682, Pensacola, Fla.

CIGARETTE HOLDER—Having a stem which is movable to effect the ejection of the cigarette stump or grip the cigarette in normal position. Patent 1551978 B. L. Brooks, Beasley Bldg, Lynchburg, Va.

FISH-SCREENING DEVICE—Adapted to be positioned between the side walls in an irrigation, or like conduit Patent 1551967. J. Nample, Reichle, Mont.

FRUIT, VEGETABLE, FISH AND MEAT DEHYDRATING APPARATUS—For dehydrating by artificial heat, the materials being distributed on wire mesh bottom trays, increasing in size as the sections ascend. Patent 1552210. M E Bussler, 521 St. Philip St., New Orleans, La.

COLLAR BUTTON—So formed as to permit the application or removal of the collar, without distorting or tearing the button hole. Patent 1548074 A. O Benson, 1641 W. 55th St., Los Angeles, Cal.

MOVABLE FORM FOR CONCRETE CONSTRUCTION.—Which can be moved from finished portions of a wall and applied to the upper edge for pouring a continuation. Patent 1550051. C. M. Alley, Upper Lake, Cal.

PROCESS FOR MAKING ARTIFICIAL MARBLE. Consisting of a mixture of calcined magnesite, sand, Portland cement, asbestos fiber, magnesium chloride, magnesium sulphate, and calcium chloride. Patent 1550077. H. J. Kimmel and L. A. Harris, 8 Railway Ave., San Francisco, Cal.

Patents on the Tax Return

ALTHOUGH it is intangible, a patent is just as real a business asset as a factory building Each year the value of this asset may depreciate, because the date of expiration when it will be worth nothing at all, is drawing nearer. Can you, then, deduct such loss from your company's tax return?

Why not? The United States Board of Tax Appeals recently in the case of the appeal of the Union Metal Manufacturing Company says:

"Section 214 (A) (8) of the Revenue Act of 1918 provides for the deduction of a reasonable allowance for exhaustion, etc., of property used in the trade or business. We know of no ground for holding that this means all property except patents. We not only have no right, but in this case we can find no sensible reason to write such an exception into the statute."

Trimming the Patent Office

RECENTLY the superintendent of the War Department held a hearing to consider the question of widening F and G Streets adjacent to the Patent Office. This would mean cutting off the portico and high steps of the building A number of persons are protesting, saying that the steps serve as a pedestal for the monument-like structure. Among other objectors is the *Journal of the Patent Office Society* which declares:

> "The removal of this beautiful portico with its double row of Doric columns would necessarily be a severe blow from an architectural standpoint."

Old timers may remember the criticism of the south front as an architectural blunder when the building was completed. The *Washington Star* of October 15, 1875, said:

> "The symmetry of the south front of the Patent Office building is sadly marred by the lately completed south entrance, the flight of steps being almost as high as the building itself."

You cannot please all of the people all of the time.

The Invasion of Canada

THE Canadian Commissioner of Patents recently issued his annual report showing that in the last year 9,506 patents were issued in the Dominion. One statement in it is as follows:

> "Of the total number granted, 6,580 were applied for by residents of the United States. This is 69 percent of the whole issue and is 4 percent more than were issued to United States inventors last year Applicants resident in Canada contributed 1,302, or over 13 percent of the total. This is a decrease of nearly 4 percent. Residents of Great Britain and Ireland and the British colonies and possessions applied for 846, or nearly 9 percent of the issue. This is the same percentage as last year."

In other words, American inventors and manufacturers have a growing appreciation of Canada as a market for American inventions.

RAT TRAP.—In which the weight of a rat entering serves to close a compartment and prevent return to the entrance. Patent 1552377. J. J. Althousen, Evansville, Ind.

SAFETY DEVICE FOR ELEVATORS.—Whereby in event of failure of the usual automatic safety device a manually actuated means is provided. Patent 1552263. D. Bird, 176 Undercliff Ave., Edgewater, N J.

METHOD OF TRANSFERRING COLORS.—From a pattern sheet using soluble dyes to a fabric, by the use of a moist cloth and hot iron. Patent 1552374 P. Yohns, 1046 Lexington Ave., New York, N. Y.

INDICATOR.—For indicating in darkened theatres whether or not a particular seat is occupied, the illumination being non-electrical. Patent 1552265. C. and J. K. Brachvogel, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, New York, N. Y.

GARMENT HANGER.—Which can be stowed away in a trunk or suitcase and occupy a very small space. Patent 1551769 J P. Paddington, 516 E. 72d St., New York, N Y

WINDOW SHUTTER AND SLATS THEREFOR. Which may be applied to an ordinary wood window frame, and is provided with novel means for opening and closing the slats Patent 1551753. L. Lane, Box 1066, Habana, Cuba.

CONVERTIBLE FIGURE TOY—Readily convertible from an ordinary doll, to simulate animals of various kinds. Patent 1552348. S. H. Rosenthal, 400 E. 3d St, New York, N. Y.

LADDER PLATFORM—Which may be removably connected to an ordinary ladder, to securely hold the ladder against the corner or side of a building. Patent 1553279 J. Wirth, 241 E 79th St, New York, N. Y

RAT GUARD.—Especially adapted for use with cables or hawsers employed in tying ships to docks or wharves. Patent 1553254 R. Mallu, 619 Eleysian Fields Ave, New Orleans, La

SPOOL HOLDER—Which will serve to support a spool of thread, and is also provided with a thread cutter. Patent 1553275. T E Washburn and Z T. Hull, Box 1041, Coalinga, Cal.

OIL CAN—Having pumping means to forcibly eject a limited quantity of oil at each operation. Patent 1553245 F I. Jaden, Hastings, Neb

DOOR FRAME CONSTRUCTION FOR BUILDINGS—Whereby the connection between the supporting frame and the plaster is unusually effective and simple. Patent 1553,-228. E. Flagg, 111 E. 40th St, New York, N. Y.

METHOD AND MEANS FOR PRODUCING BIAS FABRICS.—From non-bias fabrics, for the production of individual neckties and other articles. Patent 1553174 M. M. Kasanof, 1746 59th St., Brooklyn, N. Y.

Hardware and Tools

WRENCH—The adjustment of which may be readily made and after once set, the hand grip maintains the jaws in position. Patent 1556523. A G Hughes, 312 W. 15th St, New York, N. Y.

GRAVER SHARPENER—Adjustable to any desired angle for properly supporting the tool for sharpening, polishing or honing the cutting end Patent 1556471. E M. Andrus, 815 Third St., Macon, Ga.

SAFETY HOOK—Embodying a simple locking device, which will prevent the accidental slipping of a chain link in the logging industry. Patent 1555359. J. Delahunt, Route 1, Bow, Wash

MIXING FAUCET.—In which hot and cold water may be mixed to provide a common flow at the desired temperature Patent 1555948. A. Engel, 948 Union Ave., Bronx, N. Y.

COMBINATION TOOL.—Comprising a handle containing a plurality of implements with locking means to hold any one of the implements. Patent 1556788. P. W Hallvarson, 180 Ninth Ave. W., Calgary, Alberta, Can.

Heating and Lighting

AUTOMATIC GAS-CONTROLLED WATER HEATER.—Having thermostatic means controlling the flow of gas to the burner in accordance with the temperature of the water. Patent 1551885. H. G. Jensen, 8745 Crane Ave., Detroit, Mich.

MEANS FOR BURNING OIL.—Without the deposit of hard carbon in the vaporizer, or the internal deposit of hard carbon in other parts of the apparatus. Patent 1553986. G. S. Clyde, 788 Orange Ave, West End, Long Branch, N. J.

AUTOMATIC FIRE-CONTROL AND FUEL-ECONOMIZER SYSTEM.—For oil burning furnaces, wherein the amount of air supplied will be automatically varied according to the quantity of oil used Patent 1554869 J J McAndrews, Greenbridge St. and Coppswell Ave., Jamaica South, L I, N. Y

OIL BURNER.—Adapted to be applied to most any type of burner whereby oil and superheated steam can be efficiently used Patent 1555684. F X Mantsion, Ashton and Willits Roads, Homesburg, Philadelphia, Pa.

OIL BURNER.—In which liquid fuel is changed to a vapor, and subsequently distributed over a generating hot plate. Patent 1557954. R. E Wood, Syracuse, Neb.

Machines and Mechanical Devices

EGG PROCESSING—To preserve the eggs by submerging them for a short time in a bath of heated oil, and draining off the surplus oil. Patent 1553185 W. H. Roussel, 152 Clay St, San Francisco, Cal.

SLICING MACHINE—Which will cut strips of pearl shell commonly known as "blanks" into a plurality of buttons Patent 1553227 A. Feyk and P F Dusha, c/o Victor P. Nekarada, 230 Fifth Ave., New York, N. Y.

TUBING CATCHER—In the nature of a safety catch for use in lowering tubing into a well casing Patent 1553195. H R. Smith, Siloam Springs, Ark

DAMPER REGULATOR.—Which is provided with a pressure cap and construction of post and strut receiving and engaging the scale beam. Patent 1553236. J C. C Harris, c/o Lock Regulator Co, Salem, Mass

MACHINE FOR THE MANUFACTURE OF STRIPS OF MATCHES FOR BOOK MATCHES MADE OF WOOD, CARDBOARD, AND THE LIKE—Automatically manufacturing the strips for uniting to form a book Patent 1553,-900. W. Huhnd, c/o C Fehlert & Co, S W 61, Belle-Alliance-platz 17, Berlin, Germany

PUMP JACK—With means for preventing injury to the mechanism or associated parts of oil well equipments in the event of breakage. Patent 1553486 E. R Thomas and P. E Langfitt, Box 948, Shidler, Okla

CASTING DEVICE FOR TYPE METAL—Whereby type metal of any desired cross section can be cast in a continuous process Patent 1551838 F B Myers, Oakland, Cal

SLING—For use in the art of loading and unloading, with means for so balancing the load that it will alight firmly Patent 1551,-886 T. W Jensen, Berkeley, Cal

HEAD GATE—Adapted to be used in connection with irrigation ditches for the purpose of controlling the flow of water Patent 1551883. A G Humphrey and H C Mc Carthy, Ripley, Cal.

WIRE TENSION DEVICE—Adapted to impose a tension which may be varied at the time the wire is moving in the direction of its length Patent 1553978. A H Braid, Box 217, Summerville, S C.

CABLE-SNUBBING DEVICE—To be secured on the frame of a derrick for use in checking longitudinal movement of a cable engaged with the device Patent 1553130 D. D Bittle, c/o Comar Garage, Marland, Okla.

WATER FILTERING PLANT—The water being purified by passing through sand which from time to time is sterilized by a steam process Patent 1554129 L Ryan, 4240 McPherson Ave, St Louis, Mo

SHOVEL AND DREDGE—For light and rapid work, and may be incorporated as a unitary structure in a tractor driven by a stationary engine. Patent 1554131 J A. Scharf, 142 So. Fulton St, Richmond, Ohio

DRAFT APPLIANCE—For use with stump pulling mechanism, having means for supporting the sheath and connected parts in proper position during the operation. Patent 1553692. T. W. Huckle, c/o Ferndale Boat Works, Miles Road and Woodward Ave, Ferndale, Mich.

CHANGE-MAKING MACHINE.—Driven from a prime mover and actuated by the insertion of the coin or coins, thus eliminating the necessity of an operator. Patent 1553979. F. J Bryk, 17 Elizabeth St., Jersey City, N. J.

CASING CATCHER.—A device which may be employed to automatically serve as a means for catching a string of casing, or a section of string, in case the same drops when being lowered into, or raised from, a well. The inventor has been granted two patents of a similar nature, 1553904 and 1553905 J K Livingston, 1215 So Norfolk St., Tulsa, Okla.

MECHANISM OF UPRIGHT PIANOS—For the special purpose of obtaining a more perfect and rapid repetition of the hammer stroke on the wire. Patent 1554977 O P Borgarello, c/o G Breuer, Calle Maipu 671, Buenos Aires, Argentina, S. A.

SHOE-TREE-MAKING MACHINE—For automatically feeding the stock to the cutters and automatically discontinuing the action upon completion of the cutting operation Patent 1554878 O. Olson, 168 E. 29th St, Brooklyn, N Y.

BRICK-CLEANING MACHINE—Especially adapted for cleaning off surface collections in used paving brick, in preparing the same for reuse. Patent 1554582 T L Krupitzer, Box 220, R 7, South Jacksonville, Fla.

PORTABLE COAL TIPPLE—Having means for leveling and supporting the wheeled platform when the tipple is in use, or moved from place to place Patent 1554885. G C. Singer, Oakland City, Ind.

SNOW REMOVER.—Having means for gathering the snow, and directing it as conveyor means, in the form of a wagon Patent 1555777 D Van de Genachte, c/o Arvon Co, 105 W 16th St, New York, N Y.

EGG BOILER.—For automatically regulating the time of immersion of an egg, or other article of food, in boiling water Patent 1555491. I. W. Tufts, 2403 Carondelet St, New Orleans, La.

Railways and Their Accessories

CAR-BRAKE RATCHET.—Giving speedy action for the controlling of brakes on freight cars, especially box cars Patent 1553278. O D Willis, 633 Fourteenth St., Huntington, W. Va

RAIL FASTENING DEVICE.—Which makes it practically impossible for a spike to be removed from a tie, except by use of a claw bar. Patent 1553176. S. B. Kull, Roslyn, L I., N. Y.

GRAIN-CAR DOOR.—In the nature of an auxiliary door to be employed beneath any approved main door. Patent 1554421 J E Drake, Blue Rapids, Kan.

DEVICE FOR REMOVING SNOW AND ICE FROM RAILWAY TRACKS.—Which will clear the vicinity of the trolley slot, and remove and deflect the snow from the track rails Patent 1555778. D. Van de Genachte, c/o Arvon & Co., 105 W. 16th St., New York, N. Y.

TRAIN CONTROL.—Pertaining more particularly to means for automatically operating the engineer's valve to either service or stop position Patent 1558360 G P Horan, 12 Madison St., Rutland, Vt

RAILWAY BAGGAGE COUPON TICKET—Comprising a plurality of detachable ticket portions, each having indicia indicating transportation between designated points and the serial number of the ticket Patent 1558780 W. R Betham, Decd Mrs E. A Betham, Executrix, c/o E H Harwood, 502 Green St., South Haven, Mich

Pertaining to Recreation

GAME APPARATUS—In the form of a folding game board, with means for holding the game pieces on the board when moved Patent 1552344 D Reisz, 10010 South Blvd, Cleveland, Ohio

TOY—Designed to represent a horse, or any other animal, on which the rider can propel the same to simulate a gallop Patent 1553219 H B Crosby, 42 So Street, Calais, Me

GAME APPARATUS—Played, with representations of several types of hands cut into pieces, which may be fitted in position to represent normal or grotesque types of hands Patent 1555747 G. A Lindsay, Hotel Ansonia, 73d St and Broadway, New York, N Y

GAME—The playing of which will provide an understanding of the steps which are involved in the drilling of an oil well Patent 1555909. T A Carson, Jennings, Okla

TOY PISTOL—Formed of spring wire, and adapted to project fruit pits, marbles small stones and like pellets a considerable distance. Patent 1555912. W R. Davis, Wallace, Idaho.

TOY BALL.—Made up of hinged sections adapted to fly apart when certain portions of the ball are struck Patent 1557751 W H Winks, 404 E. Randall St Baltimore, Md

STRIKING BAG—For exercising purposes, the bag permitting the use of a laced side opening and a complete closure at the reduced portion Patent 1557938 B Kennedy, c/o Ken-Wel Sporting Goods Co, Gloversville N Y

Pertaining to Vehicles

BOLSTER AND STANDARD CONSTRUCTION—For wagons or like vehicles, of light weight and at the same time strong being made entirely of metal Patent 1554909 N J. Eldridge, c/o Wm Muller, Grand Island, Neb

VEHICLE SEAT—Particularly adapted for the driver's compartments, the seat being attached to the side wall of the car swinging outwardly to provide access to the interior Patent 1554872 J E Meyer, c/o B. T Bush, Delawanna, N J

SPEED INDICATING DEVICE—For use on motor vehicles indicating to the public and driver the speed, or approximate speed at which the vehicle is traveling Patent 1555300 Samuel R. Mott, 4500 Euclid Ave, Cleveland, Ohio

SIGNALING DEVICE FOR AUTOMOBILES—Which may be worked from the interior of a closed car to indicate the direction of travel, or a stop. Patent 1555193. G. Elbert, 809 E. Second St., McCook, Neb

ADJUSTABLE AUTOMOBILE TABLE—Adapted to be extended across the interior and to effectively engage the sides in supporting relation Patent 1555038. R F. Thweatt, c/o Thos B. Losey, 504 1st Natl Bank Bldg, Chickasha, Okla.

ATTACHMENT FOR ACCELERATOR PEDALS—By means of which the operation of the pedal is steadied, preventing the sudden, jerky opening and closing of the throttle Patent 1554492 J M. Brennan, 630 W 36th St., Los Angeles, Calif

VEHICLE WASHER—In which the vehicle may be passed between brushes for the purpose of removing dirt from the sides Patent 1555754 J Peterson, 1542 103d St, Ozone Park, L. I, N Y

AUTOMOBILE PARKING MACHINE.—In the nature of vertically and laterally movable platforms, for supporting and storing a large number of cars in a relatively small space Patent 1555692. J. E. Morton, 5 Murdock Aptmts., West Lafayette, Ind

MOTOR WAY—Comprising specially arranged tracks for slow moving and fast moving vehicles, on a roadbed of comparatively light structure Patent 1554425. C P Eldredge, Mill Valley, Calif

SPRING OILER—Which utilizes a pressure of air to separate the leaves of springs while lubricant is forced between them Patent 1556460 F Thill, c/o Saunders, Young & Grann, 144 N E 2d Ave, Miami, Fla

COMBINATION WHEEL.—Of the combined cushion and pneumatic type, in which the road-engaging surface is in the form of a cushion tire Patent 1556450 J Makant, Box 13, West Haverstraw, N Y

REFLECTOR—Including a movable shield, operable by the driver for modifying the light rays of headlights, whereby glare is eliminated Patent 1557277 J R Stoney, Box 83, Ouachita, La

CUSHION TIRE—In which the maximum amount of resiliency will be had under the strain of a heavy or a light load Patent 1557324 S Pestunowitz, 58 Hillside Place, Newark, N J

HEADLIGHT—Supported to turn with the steering wheel so that the rays of light will be projected directly in advance of the automobile Patent 1558343 G Cook, Gillett, Wis

Designs

DESIGN FOR A HAND BAG Patent 68334 H Margolin, 1237 Broadway, New York, N Y

DESIGN FOR A CHILD'S COAT—Patent 68404 Maude Siegel, c/o Franklin Simon & Co, 38th St & 5th Ave, New York, N Y

DESIGN FOR A DRESS—Patent 68405 Maude Siegel, c/o Franklin Simon & Co, 38th St & Fifth Ave, New York, N Y

DESIGN FOR A RING—Patent 68378 H. G. Kaufman, c/o Milton Weinberg, 1440 Broadway, New York, N Y

DESIGN FOR A FILM REEL—Patent 68397. B. Petrowsky, c/o Paragon Auto Parts Co., 506 W. 58d St., New York, N Y

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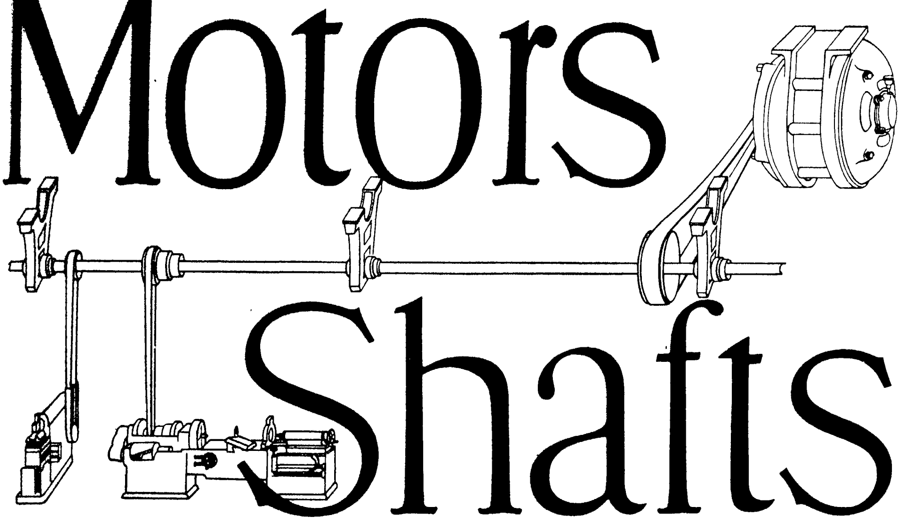
Motors



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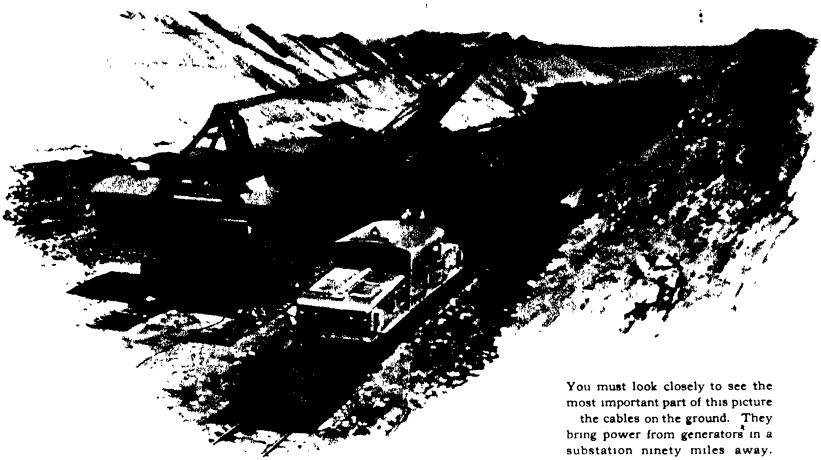

You must look closely to see the most important part of this picture the cables on the ground. They bring power from generators in a substation ninety miles away.

Digging coal by wire

To help industry and the railroads do their work more economically is an important service, but to save human energy is even more important The General Electric Company design and manufactures the equipment by which electricity does both

TO the Northern Pacific Railway belongs the credit for this thrifty achievement in coal supply.

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Industry after industry owes a similar debt to electricity. It is continually tapping natural resources that mankind could not otherwise have enjoyed for another hundred years.

GENERAL ELECTRIC

SCIENTIFIC AMERICAN

FEBRUARY 1926

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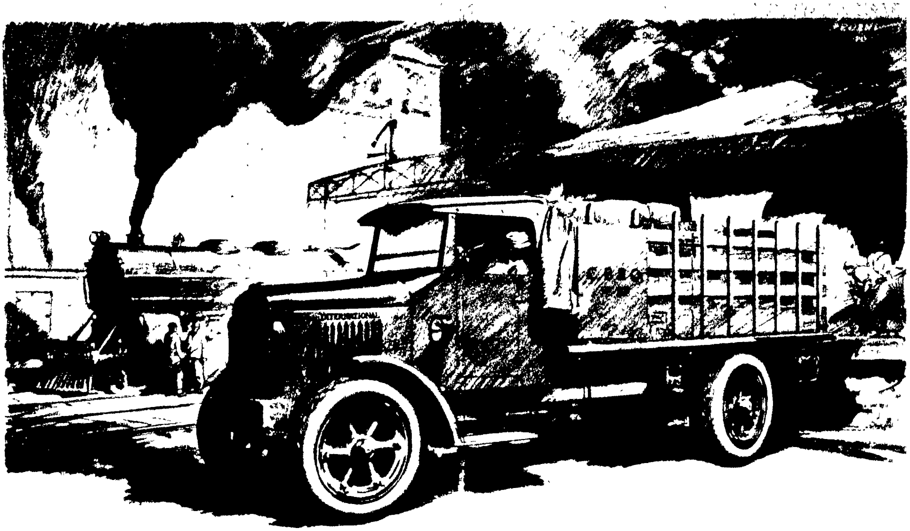

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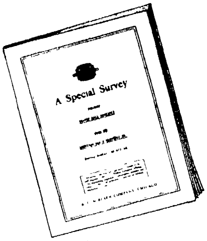

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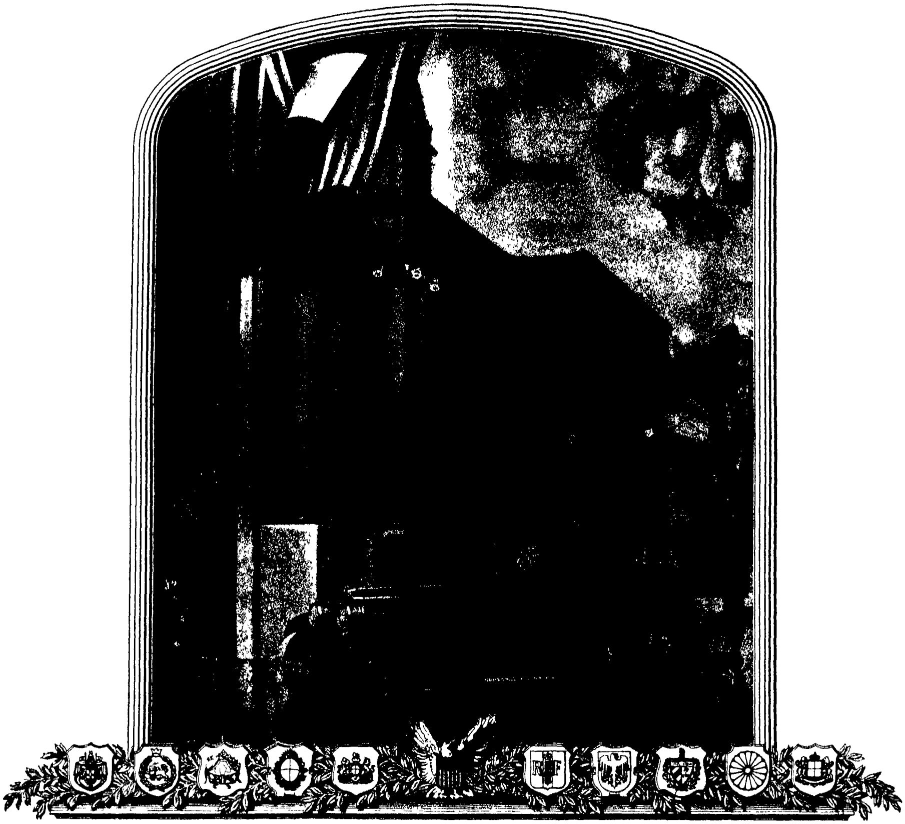


THE AMBASSADORS' CHOICE

Those who are selected to represent this country at the courts of the great capitals must in turn select the things which will be in keeping with the importance of their missions.

Ten prominent diplomats have recently chosen Packard cars as affording that distinction so necessary to their business and social activities.

In England, a Packard Six has appeared at the Court of Saint James's; while in France, an Eight has stood, an object of beauty, at the gates of the Palais de l'Elysée.

In either Six or Eight is found the full measure of Packard beauty, Packard distinction and Packard dependability.

PACKARD

Ask The Man Who Owns One

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, FEBRUARY, 1926 EIGHTY-SECOND YEAR

FUTURES

THE recent announcement of the development of the Zworykin Thermionic Tube presents one of those opportunities to speculate on future development which is impossible to resist. A combination of the photoelectric cell and the radio vacuum tube, its sensitiveness is infinitely greater than anything yet developed. Variations of light falling on this tube instantly become variations by electrical current, amplified approximately one hundred thousand fold.

An alkali metal, such as potassium, is coated on the inside of the radio tube When light falls thereon a shower of electrons is thrown off. Variations of the strength of the light vary the shower, infinite gradations being possible. This shower is tremendously amplified and produces a current sufficient to operate the ordinary relay, thus making it applicable for any purpose

Peering into the future one can see limitless applications in commerce, war, astronomy, physics and in the more humanitarian aspect, the turning of printed words into musical sounds for the blind.

SLUMBER

IT is wrong in families where there are children to cease all noise when the babies are asleep It is much better that the child should be prepared for the rough and tumble of later life by being allowed to sleep with noise going on everywhere. This is the advice Sir Harry E. Bruce-Porter, children's specialist, gives the National Society of Day Nurseries.

Dr. Bruce-Porter, let us ask you one question. Did you ever walk the floor at night, back and forth, back and forth, and finally get the baby to sleep? Then did you succeed in laying the baby down so gently and carefully that he still slept?

Then, Dr. Bruce-Porter, did you dare make a noise?

HOAX

THE great to-do in the newspapers about the discovery of lead crosses and other relics alleged to prove that a tribe of wandering Jews dwelt in the Southwest for a couple of centuries, long before Columbus made his famous trip beyond the edge of the world, seems to have been somewhat premature. The discovery appears to be a hoax.

The relics are said to bear dates such as "775 A.D." Now it happens that the use of the letters, "A.D." did not become general until long after the year 775. This reminds us of some bogus pre-Christian coins that were found bearing the date "445 B.C.," stamped into the metal!

In This Issue

Where Is the Food to Feed Our Immigrants?
Immigrants are steadily increasing our population. As they fill up the country, our lands available for raising crops and stock are shrinking. How can we produce food enough for these newcomers, or even for ourselves? So important do we think the question that we have made it the leading article of this issue. Page 77.

Time to Begin Your Telescope
Hundreds of our readers have written us that they were impatiently waiting for instructions on telescope making. Here, then, beginning on page 86, are four pages of them, and more will follow next month. The author is a past master of telescope making, for he has made scores of them.

Can Man Transmute the Elements?
"No," say many scientists, "man cannot, because he has no access to the vast forces that are necessary to accomplish this miracle. Nevertheless two European scientists claim to have done it. How they went at it is told on page 80

What Do We Know About Life?
Each of us is a sample of life, yet we do not even know what life is. We may never know. Again, we may learn tomorrow An American scientist has succeeded in imitating the life processes. Page 82.

America's Last Frontier
Northern Alaska at last yields up its secrets The story of the Government surveyors, the first white men to see much of the region, is full of romance, danger and hardship. Page 102

MORE THAN 175 PICTURES

Complete table of contents will be found on page 114

For Next Month

24,000,000,000,000,000,000,000 Cycles a Second
A new ray, with a frequency 1,000 times that of the X ray, has been discovered by Dr. R. A Millikan, most noted American physicist, Nobel Prize winner The newspapers have garbled the account. Get the truth from Dr. Millikan himself.

How Will You Mount Your Home-made Telescope?
There are several ways, ranging from simple to complex, and Mr. R. W. Porter, who contributes an epochal article to the present issue, will tell you, next month, how to do it.

Romance in Railroading
How many of the people of the United States have any knowledge of the Alaska Railroad? In our March issue we shall publish, by the courtesy of Secretary Work, a beautifully illustrated article by Noel W. Smith, general manager of the line, which will make you familiar with this great work.

Other articles on Poison Gas on the Farm; Greenland's Historic Mystery; The Subjugation of the Colorado, House Ventilating; Radio; Astronomy

MORE THAN 175 PICTURES

¶ ***Applied science has for its aim efficiency—getting the greatest results for the least expenditure of time, labor and material. Why not apply science yourself? Get the maximum in pleasure and practical information by the simple process of sending four dollars for a year's subscription to the Scientific American.***

PROGRESS

"LONG distance phone service between Egypt and Palestine is the latest modern device for the elimination of the long, weary distance over which Moses and Aaron led the children of Israel back to the Promised Land. Telephone conversations are now possible between the principal cities of the Holy Land—Jerusalem, Telaviv and Haifa—and Cairo, Alexandria and Port Said, in the land of the Pharaohs The wires stretch across the Sinai Desert, which the Israelites traversed in their wanderings in the wilderness"

The surprising thing about this bit of news is not that telephone communication between these two centers in the Near East is now possible, but rather that for all these years it has *not* been possible. Suppose an American business man on a tour of the Orient last November had learned when in Cairo that an old chum was in Jerusalem, he would have attempted to reach him by long distance telephone In nine cases out of ten he would have been amazed to learn that it could not be done.

It has been a long time coming, but at last the doom of the "Cedars of Lebanon" seems near, they may be cut into telephone poles

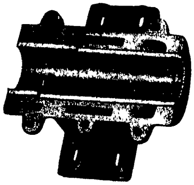
BRIDGES

THE broad waters of the Hudson River are such a hindrance to the free transfer of freight and passengers between New York City and the rest of the United States that an ample provision of bridges of the first magnitude is obviously the only means by which this commercial separation can be overcome. The question of bridges versus tunnels, as a means of crossing the river, has been debated *ad nauseum;* and unfortunately most of this discussion has missed the great underlying fact that, for a given outlay of capital, you can secure from two to three times as much capacity from bridges as you can from tunnels This fact has recently been urged by Samuel Rea, who recently retired from the presidency of the Pennsylvania Railroad Company He can speak with authority on tunnels, since he was largely instrumental in building the first tunnels those of the Pennsylvania Railroad, to reach New York from the west, yet only recently he stated: "I am still firmly convinced that no system of tunnels can ever do as much for the city as a bridge, properly located"

The building of the North River Bridge would provide the quickest relief to the present inadequate transportation facilities across the Hudson and would greatly assist in reducing port and harbor congestion.

A few of the more than 2000 Jones-Willamette Bearings in use at the Crown-Willamette Paper Co. Plant, one of the countries largest paper mills . . . Heated rolls, great pressure in addition to normal load, water and high speeds make paper mill service a severe test for any bearing.

What *wouldn't* this bearing do in *your* plant



LEAKLESS
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Action of shaft automatically filters and circulates oil to points of greatest load and friction. Complete lubrication means long life. Bearing completely oil sealed — oil cannot escape nor water enter

A bearing which uses pints of oil instead of gallons. A bearing which runs cool in the most exacting bearing points. A bearing which eliminates oil leakage and the resultant damage and fire hazard — one which radically cuts power losses from friction and makes shut-downs for bearing service and replacements practically unknown. These are but a few outstanding advantages of the Jones-Willamette Bearing.

For several years this remarkable development in bearings has been in actual service in some of the principal paper and textile mills, lumber mills, power plants and mines of the Pacific Coast. Users have grown more and more enthusiastic as continuous actual use has conclusively proved its economy.

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Write for full particulars. The Willamette Engineering staff is at your service in working out a solution for *your* bearing problems.

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Bearings

THE present immigration law of the United States attempts to do two things. First, it limits the total number of immigrants admitted in each year. Second, it selects those to be admitted from certain races and nationalities, to the exclusion, relatively at least, of other races and nationalities These are the effects and intentions of the "quota" provisions

These two chief intentions of our present policy are based, presumably, upon two ideas concerning the real facts about immigration First is the idea that some selected races, peoples or nationalities are better material for our citizens than are people of other population groups. Second is the idea that we need no more people in the United States—or very few more—and that restricted immigration will leave more of the good things of life for those of us who are already here.

In the present article I propose to think aloud about the second idea that underlies our immigration law; the idea that limiting the stream of immigration will serve, somehow, to release us from the danger of overpopulation This idea seems to have little real logic behind it

We Must Be Informed

It must not be assumed, however, that the present immigration law is all bad. When we remember that the law was dictated, not by logic, but by passions, prejudices and political necessities, we can find words of praise for both law and lawmakers. *It is quite possible, even, that the restriction of immigration is temporarily wise and that the selection by quotas is not so bad in practice as strict logic would compel us to decide.* Questions of practical politics cannot always be decided as logically and scientifically as they will be, doubtless, when we attain Utopia.

So this article need not be taken as an attack on the present law or as a plea for its removal from the statutes. That is not the point at all.

What the point is, is this. We need facts. Some day we will have to draw a new immigration policy for the United States. It is one of the problems that must be settled and settled right, before the future of our country is in any degree secure. The present law may be right. If so, that circumstance is a happy accident. This law, however, is illogical. It is based upon ideas that are untrue. Let us attempt, while the present law provides some emergency protection, to reason out among ourselves some true principles of human migration. let us collect and examine what we do know. Let us see what more we need to know No single authority can pretend to settle the immigration question for you. On the contrary. But it is not amiss to indicate some of the facts by which you can settle it for yourself.

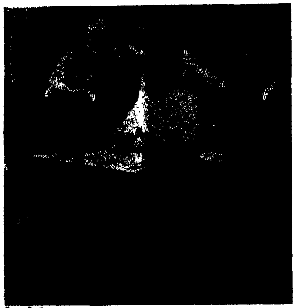
The discussion of the immigration question involves what is probably the most serious problem of the world today; the problem of overpopulation Are there, or are there not, too many people in the world? Are there—coming closer home—already too many people in the United States?

The answers to these questions depend mainly on the facts of food supply It is obvious that there is still plenty of standing room on earth There is ample room, even, for every man, woman and child to have a house What fails is, as we say, a "good living" for everybody This reduces, in the last analysis, to food

Modern society has grown so complex, we earn our individual livings in so many different ways, that the real simplicity of the problem of keeping alive on earth has grown obscure. For example, to a man who sets down figures each day in a ledger and who receives for this labor a piece of paper which he exchanges for some small, tin cylinders in which he finds green peas or succotash, it seems unreasonable that his living depends on the wheat crop of Argentine, or, for that matter, on the corn crop of Iowa. Yet this is fact

It may be love that makes the world go round but it is wheat and beef and succotash that keep us alive to watch it spin If more immigrants can come into the United States, can find land to live on and can make this land, plus their labor, yield enough food to keep them happily alive, then by all means let those immigrants come. If, on the other hand, we are pressed, or likely to be pressed, by shortages *of land or food, then let us take steps* somehow to prevent any increases of our population, both the increase due to immigration and, if we can manage it, the increase due to the expansion of families that are already here

This matter of the relation between population and food is so persistently misunderstood that it is worth while to try to make it clear by a much simplified model of society.



Brown Brothers

AT ELLIS ISLAND

A group of newly arrived immigrants waiting to be examined by United States Government officials

Population on an Imaginary Island

Suppose that there exists somewhere in the world an uninhabited but fertile island containing exactly one hundred thousand acres of agricultural soil. Suppose that two hundred people, men and women, land on this island Suppose, further, that each family of a man and his wife can till to advantage exactly one hundred acres of land.

Let us ignore, for the moment, such excrescences of civilization as the banker, the policeman, the blacksmith or the thief All of our islanders are supposed to be farmers Each family of two will appropriate and farm its one hundred acres This will absorb, usefully, ten thousand acres of land, or one-tenth of the island Nine-tenths of the island will be left unused—and, for the moment unneeded

But the population of our island will increase On the average, there will be more than two children, so that when the parents have died there will be a net increase of the inhabitants These new individuals will marry off, two by two, and will take up each pair its one hundred acres out of the nine-tenths of the island that remains unused In time all of this remaining nine tenths will be filled

So far we have followed what some economists call the "pioneer" stage of a civilization As population increases, more and more land is brought under cultivation Even if immigrants come to our island no trouble is created. There is still plenty of land. The immigrants simply go, two by two, and cultivate their hundred acres of the common patrimony. Essentially, that was the situation of the United States during at least the first century of its existence as a nation. Whether or not it is still the situation of the United States is the question which we are examining

For simplicity let us continue to think of our island. The population has now increased—whether by births or by immigration is immaterial—until the island is full Each pair of adults has its one hundred acres of land. What shall the islanders do about further increases of population?

It might be possible, you will say, to place more than a single pair of adults on each one-hundred-acre farm. Each family might arrange, for example, to employ a hired man and thus to produce more food from the same area of land.

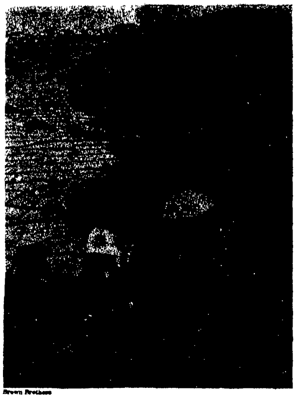
To some extent this may be possible—it is occasionally and partially possible in real countries conducting real agriculture But our islanders, like the real farmers, now run against what economists call the "law of diminishing returns"

The Ultimate Yield of Land

There is a certain amount of labor and a certain amount of land, which yield, in combination, the maximum proportional amount of food. We have assumed for our imaginary island that this maximum productivity is attained by the ratio of one family to each one hundred acres of land. If we add another adult laborer, or two additional adult laborers, or three laborers, and so on, we may get more food but we will not get *proportionately* more food

Suppose, as a convenient unit, that each adult eats one bushel of corn a month. And suppose that the original two-adult family could raise on their hundred acre farm just four bushels of corn a month, that is, just enough for them to eat Now we add another adult. His labor increases the yield of corn, let us say, to five bushels a month. He cannot add his full share of another two bushels, for we have assumed that the ratio of two adults to each farm means maximum productivity and the most favorable possible use of the land.

What has happened? By placing one too many persons on the land we have increased the corn consumption to six bushels, while increasing the production to only five bushels. Each person can have only one and two-thirds bushels to eat, instead of the full two bushels that is the normal diet. In the language of economics, we have forced a reduction in the "standard of living."


Brown Brothers

IN FAR JAPAN

Where agriculture is very intensive. Here we see terraced tea plantations on the hills and rice fields in the valley

Now this parable of the overpopulated island applies exactly to the United States and to every country in the world. Do not be confused by the incidental complexities of the real world. On our island we assumed that every acre was alike and that every farmer was alike. In the real world these assumptions do not apply Some farms are more productive than others; some farmers are more able than the average, and can make productive use of more land. But on the average these differences cancel out. The food—and happiness and prosperity—of men depend upon the sum total of food that they can wrest from the soil and from the sea, and upon the sum total of living humans between whom this food must be divided

Do not be confused, either, by the extreme diversity of modern occupation. Not all of our citizens are farmers. How do they fit into the economic parable of our agricultural island? This, too, is simple. Suppose that the islanders hire a blacksmith. He lives somewhere on a tiny bit of land, only large enough for his house. He has no farm. He raises no food. What he does do is to forge plowshares for the island farmers. They pay him for these plowshares in food. Thus he gets his food. He lives without personal contact with the soil.

Why can the farmers afford to do this? Because the plowshares which the blacksmith makes for them help them to raise more food with the same amount of labor. They postpone the application of the "law of diminishing returns." Each family finds, let us imagine, that with the help of the blacksmith's plowshare they can raise four and a half bushels of corn each month instead of only four bushels. They can afford to give half of this increase to the blacksmith. Both of them will be ahead. The "prosperity" of the community is increased.

Have We Plenty of Land?

You can apply this for yourself to all the multitudinous "industrial"—that is non-agricultural—activities of a modern state. The banker, the policeman, the railway builder, the surgeon and all the others are worth their keep only when their work results, as does that of the maker of plowshares, in increasing the amount of food that one man can produce, on the average, from one acre of his country's land.

Now for the practical problem of the United States. Are we still in the pioneer stage, with more land available for an increased population? Or have we encountered already the point of "diminishing returns," after which any increase of population, from any cause whatsoever, must mean a lower average standard of living for our population

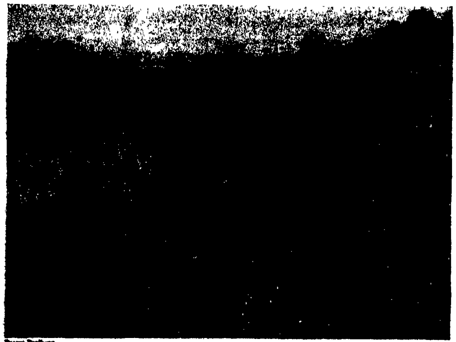
The answer is a matter of opinion On the face of the statistics there is plenty of land still available. The area of the continental United States is 3,036,789 square miles. Only about 1,500,000 square miles of this is recorded by the census as being "in farms." Even when one allows for the parts of the west which are used for stock raising or for other purposes, without being technically within the census figures, the statistics seem to indicate that not much over one-half of the area of the United States has been put to use in the production of food

But statistics are tricky things. Of this supposed one half of our land inheritance that remains to us, very little is of any real value. Much of it is rocky and mountainous. Another large fraction is desert,

Brown Brothers

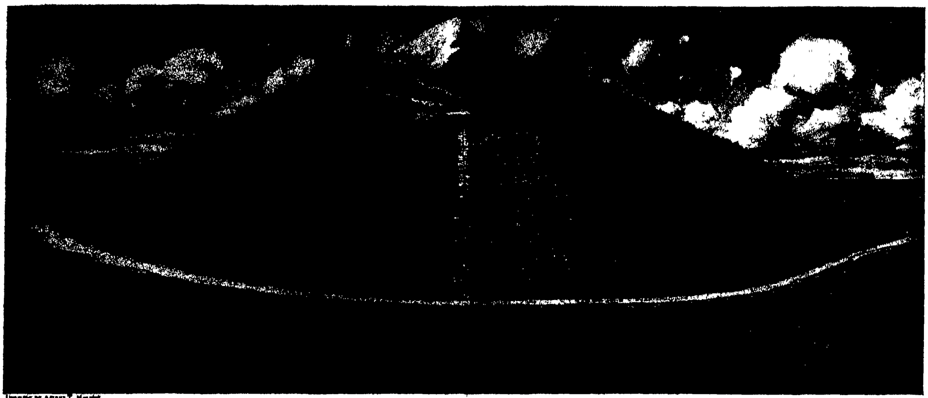
ON THE SIDEWALKS OF NEW YORK

A typical scene in the streets of the East Side of New York, where a congested foreign population lives, or perhaps more properly, exists, and does business


Brown Brothers

A RELIGIOUS FESTIVAL DAY IN INDIA

India, too, is overpopulated In this picture we see a multitude of Indian worshipers who have flocked to the Ganges to bathe and wash their sins away



Drawing by Arthur T. Merrick

OUR IMAGINARY ISLAND WHERE LIFE IS SIMPLE

Until overpopulation makes it complex When too many people must be fed from too small a plot of land, the standard of living must necessarily be lowered

and the artificial reclamation of such desert lands is slow and expensive. Another part of our statistical resources consists of swamps and unreclaimable forests. Still other lands are infertile and it is useless to attempt to farm them.

It happens that I have had opportunity to observe agricultural conditions in every part of the United States. It is my opinion that our useful land is already exhausted. Our population is increasing by excess of births over deaths, to say nothing of immigration. Our land cannot increase. The fact of approaching overpopulation is a mere matter of arithmetic.

A word is necessary about two supposed ways of escaping this danger of overpopulation.

One is the policy already in practice in England. England does not produce enough food for her population. She makes manufactured articles instead. These she sells abroad, receiving in return enough food for her needs. The recent war was a sufficient exposure, I imagine, of the danger of this policy.

We Are Faced with Overpopulation

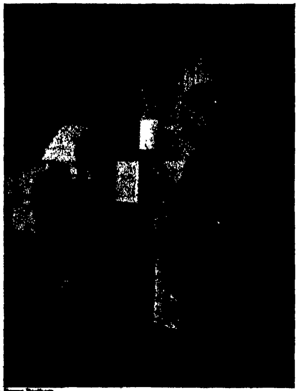
The second door sometimes suggested as an escape from the threat of too many citizens is the possibility of increasing the average productivity of the soil. The scientist who makes each ear of wheat yield an additional grain may defend us still longer. Agriculture remains capable of scientific improvement. But this will be, at its best, merely a postponement of the inevitable catastrophe. The flood of humanity rolls on. Nature's ancient reducing devices of war and pestilence we are attempting, with much success, to banish forever from the earth. We have lengthened the average life of Americans by eighteen years. We must pay for these successes in the coin of lessened food.

I do not see how anyone can escape the conclusion that we are faced, presently if not now, with a definite overpopulation of the United States. And I do not see how that can result otherwise than in an average reduction of the standard of living. Possibly this reduction will be spread more or less evenly over all our citizens. Perhaps, on the other hand, we will develop a stratification of society; a peasant class marked off distinctly from the classes of the well-to-do.

In either case, a reduction we must have, unless science takes some utterly new step like making food out of the air or contriving stomachs that do not have to be filled at all. Such things, I suppose, are possible; but they are too fantastic at present, for the realm of practical politics.

If this be true, you may conclude that it supplies an argument for the drastic restriction of immigration. The United States has too many citizens now. Why let in any more at all?

I do not look at it so. The problem of overpopulation is not created by immigration. If there had been not one immigrant admitted to the United States in the last ten years we would still be faced with an approaching lack of food. The really important sources of population pressure are the excess of births over deaths and, more important still, the lengthening of the average length of life by modern efficient methods of disease prevention and bodily repair.



Brown Brothers

THE INTELLIGENCE TEST

To insure a higher type of future citizens, we need a strict application of intelligence tests to our immigrants

There is only one real cure. That is some way of limiting births. But the present propaganda for birth control has not yet received the sanction of the scientific professions, let alone of the sociologists or the clergy.

With regard to immigration, any attempt at restricting of the total of admitted immigrants is but a palliative. Such an attempt would be about as ineffective as pouring a bucket of water on a burning forest.

But there is one thing that a wise immigration policy might do. It might help us to increase the average competence of our population. There are too many Americans, both native-born and immigrant, who are quite definitely and demonstrably no good. They are not helping to produce their share of the food.

We Need Better Americans

This improvement ought to begin at home. The worst immigrants that anybody could be induced to admit would compare quite favorably with considerable elements of our present population.

But self-improvement is perhaps impossible just now. So let us use the immigrants as one way to improve ourselves. Let us admit no immigrant who is not actually and demonstrably *better* than the average American. To admit that it is possible for him to be better may hurt our pride, but pride butters no parsnips.

The next question is how? Is it possible to contrive an immigration policy that will select immigrants who are potentially better than the average American, who will probably be able to increase the average productivity of our agricultural population? Possibly so, possibly not. Suggestions along this line are future possibilities. They will not involve any criteria of race.

Whether this be possible or not, it is at least something to know what we are trying to do. We ought not to try merely to limit the total amount of immigration. That will do no good unless we also limit ourselves. What we ought to try for is new citizens who will raise the food producing average of this economic island that we call the United States.

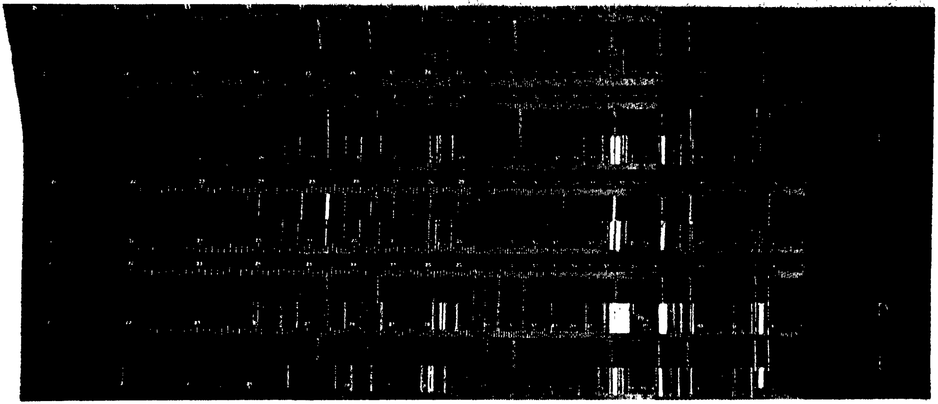


Figure 1 The spectrographs of the first and unsuccessful series of experiments, which failed owing to difficulties in the technique

The Transmutation of Elements

Using the Quartz Mercury Vapor Lamp, Two Dutch Scientists Claim to Have Changed Lead into Mercury and Thallium

By Professor Doctor A. Smits and Doctor A. Karssen

Laboratory of General and Inorganic Chemistry, University of Amsterdam, the Netherlands

IN our first paper, published in the October, 1925, issue of the Scientific American, we gave a brief description of the experiments which we are carrying out in order to determine whether lead can be transmuted into another element As our experiments are now far enough advanced for publication, some of the results will be communicated here

Two series of experiments were made, the first of which, owing to certain complications, was indecisive. The second series, however, resulted in the transmutation of the element, lead, into mercury and thallium.

Since in our experiments we were investigating the possibility of transmutation into mercury, it was necessary from the first to avoid the use of a mercury air pump and a mercury manometer Therefore, the lamp employed was evacuated by a carefully cleaned, metallic pump, connected with two V-tubes placed in liquid air; and finally by a large vessel, filled with coconut carbon It was also cooled in liquid air, a method by which a high vacuum could be obtained

Efforts to Obtain Pure Lead

When not working in a vacuum, the pressure was measured by a glass-spring manometer provided with a calibrated scale; working under pressure, the connection with the coconut-vessel was broken, and purest nitrogen was let in.

It is obvious that in such a piece of research as the present the materials used must be as pure as possible. At first, then, the experiments were carried out with "pure" lead supplied by Kahlbaum later, in order to forestall every form of contamination, especially that by mercury vapor, this firm was so kind as to prepare for us with the utmost care, new "extra pure" preparations. Following out our wishes, when it became necessary for Kahlbaum to use a high vacuum in the purification of this mercury, high vacuum pumps which operated without mercury were employed by them, just as by ourselves, and it is a fact that in their new lead preparation marked "extra pure," neither mercury nor thallium could be found analytically

In addition to these necessary precautions the quartz parts of the lead lamp were cleaned with a solution of potassium bichromate and nitric acid, steamed and finally were heated in a current of hot air until they were red hot. Likewise, the metallic steel parts of the lamp were cleaned and heated to redness, while the carbon valve suffered quite the same operation.

The procedure in the investigation was now as follows: After filling the lamp with lead, the latter was heated in a high vacuum until it was red hot The lead oxide coating now being completely dissociated, the surface of the liquid lead became as brilliant as mercury

PRODUCING MECHANICAL OSCILLATION

Figure 2 In order to circumvent the heating effects due to the use of direct, uninterrupted current, the circuit was broken at regular intervals by means of this device

The lamp was left to burn in vacuum at about 25 volts and about 36 amperes The spectrum was now photographed by means of a Hilger quartz-spectrograph. At the same time the spectrum of a mercury lamp was photographed with the scale superimposed, in order to facilitate the comparison of the different spectra. (See Figure 4, Ao.)

We burned our lamp in a vacuum as well as under pressure up to .5 atmosphere. In the latter case the voltage was increased to 120 volts, but in every case the spectra were always photographed under exactly the same conditions—that is, in vacuum, at about 25 volts and about 36 amperes

The first experiments were indecisive, but important.*

The First Attempts Were Failures

In our first experiment the lamp was burned at 36 amperes and 80 volts, with the result that while at first the lead spectrum showed only the mercury line 2536 Angstrom units, after six hours burning the strongest mercury lines in the visible as well as in the ultra-violet part of the spectrum had distinctly appeared

Further experiments made by using various voltages and currents indicated clearly that it was current density rather than voltage which influenced the results, and that the first voltage and amperage used were very favorable. It was also of interest that even though running the lamp for many hours at low amperage, no lines appeared, thus justifying our methods of keeping the lead free from contamination.

Returning to the initial voltage and amperage (25 amperes, 80 volts) a positive result was again ob-

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*EDITOR'S NOTE: Owing to limitations of space, it was necessary to shorten the account of the first and unsuccessful series of transmutation experiments The next nine paragraphs, therefore, are an abstract of the original paper

tained. After ten hours the strongest characteristic lines of mercury and also of thallium were obtained, both in the visible and ultra-violet parts of the spectrum.

This indicates a transmutation of lead into thallium and mercury.

In accordance with our experience that high current densities were necessary, we next experimented with currents up to 50 amperes, but only by intensive air cooling could melting of the quartz lamp be prevented. On this account we thought it better to alter our method a little, applying not direct or uninterrupted current, but sparks of high current density.

We therefore constructed an apparatus as shown in Figure 2, which could be oscillated mechanically in such a manner as to obtain sparks of high current density. On making contact the current was about 100 amperes, and on breaking it was considerably higher.

After sparking, a black film appeared on the lamp, which was removed by continuous running for some hours, after which the photographs were taken. In Figure 1 are shown a number of spectra taken in this manner. In each case the spectrum of mercury is shown for comparison, and below it the spectrum of the material in the lamp. Going down the figure are photographs taken after increasing time of sparking.

The Attempt That Did Not Fail

If we study the lines carefully it will be seen that *the only line in the spectrum of our lamp's contents* corresponding to a mercury line at the beginning of our series (Figure 1, A) is the line 2536. Other lines appear in the later photographs, and finally all the mercury lines appear. Of course, many which are to be seen on the plate are lost in reproduction. (The line 2802 is a lead line near the mercury line 2804.) It should be noticed, however, that as we go down the series, the mercury lines increase in brightness, then decrease later as shown in Figure 1, E, which was taken later than Figure 1, D (Use 2536 for example). This we believe to be due to the deposits which appear on the lamp. These consist of lead silicate, silicon, and later, thallium silicate is added. The evaporation of these substances from the wall, when hot, results in a high vapor density near the walls and an increased radiation of the lead lines and of the thallium lines. As the mercury does not play any part in this it can only result in a weakening of the mercury lines by absorption.

THE LAMP THAT TRANSMUTED LEAD

Figure 3. Showing, near the top, the extra vertical tube surmounted by a nickel mirror. This arrangement made it possible to study the transmutation with the spectroscope

This, however, is a minor point, the interesting thing being that mercury lines appear at all.

In order to render ourselves independent of the film formation, we once more altered our lead lamp and this time, we were successful in our attempt to transmute lead into mercury and thallium.

At the place where the arc is formed, although *the temperature of the lamp is never very high*, a quartz tube of fifteen centimeters length and eight centimeters inner diameter was sealed in, the upper end having been provided with a flat top.

The light of the arc, passing through the unattacked quartz top and then reflected by a nickel mirror, was directed at the quartz spectrograph as shown in Figure 3. The transmutation could now be studied as long as the lamp stood up.

We now started again with "extra pure" lead from Kahlbaum's, marked "L" and this in a lamp which again showed a mercury-free spectrum.

To provide a good criterion, in Ao, Figure 4, the real, initial spectrum of the "extra pure" lead is given. It must be mentioned here, that the light of *the quartz mercury lamp* is not reflected *by a nickel mirror but only the light of the quartz lead lamp*; here the light in the *ultra-violet part of the spectrum* is weakened a little.

After five hours of sparking (or, in total, eight and three quarter hours) we obtained with an exposure of fifteen minutes photograph shown at B, Figure 4.

This shows that along the whole lead spectrum the mercury lines are dominant!

After five hours, twenty-five minutes of sparking (or in all, fourteen hours, ten minutes) we obtained, after a ten minute exposure, photograph C, Figure 4. It shows how strongly dominant are the mercury lines in the lead spectrum. The lead lines are considerably weakened and the mercury lines are very strong.

The striking result just given seems to justify the expectation that if the lamp had a long enough duration of life, the point could be reached where the lead spectrum would have disappeared completely.

Even this would not, however, prove that the transmutation was exceedingly strong, for as is well known, a relatively small amount of mercury can cause the spectrum of another element to disappear.

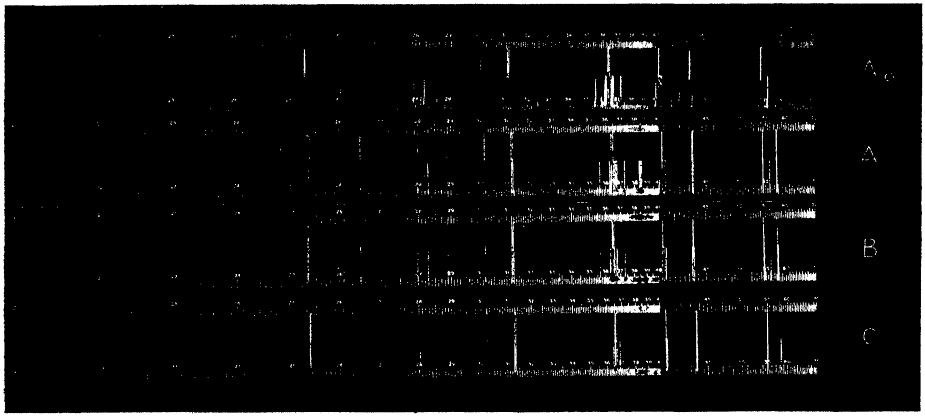
A Demonstrated Transmutation

This last series of experiments have demonstrated to us in a convincing manner the transmutation of lead into mercury. Further, it again proves that our inferences as to the reason why the mercury lines faded out, whereas the lead lines faded out with continued sparking, are correct.

The reason why the lead lines become stronger must lie in the influence of a strongly heated film in the quartz tube. Consequently Figures 1 and 4 agree completely.

It is interesting to observe, that while applying the first method of observation, some thallium lines appear distinctly; these lines are weak or are not perceptible at all in the second method. The explanation of this fact is probably that, like lead, thallium is taken up by the quartz wall.

In the next paper we will communicate the results of our quantitative determinations and give some theoretical considerations of the transmutation found. (Amsterdam, November, 1915.)



SOME OF THE SPECTROGRAPHS OBTAINED FROM THE SECOND SERIES, IN WHICH LEAD WAS TRANSMUTED INTO MERCURY AND THALLIUM

***Figure 4:** These spectra, beginning with the comparison spectrum (mercury) Ao at the top, form a series. As the sparking progresses, the mercury lines in the lead spectrum became stronger and stronger, while the lead lines weakened; if the lamp had endured long enough, the lead spectrum probably would have wholly disappeared*

Dr MacDougal and (on the left) Dr Clarke, the author, trying to duplicate the elusive life process with the artificial cell

What Is Life?

The Puzzling Phenomenon Called "Life" Is Being Studied by Means of a Working Model of a Living Plant Cell

By Beverly L. Clarke

WE are so far from a perfect understanding of life that even active workers in biological research cannot agree as to the real nature of life—whether it is purely a matter of chemistry and physics and evolution and chance, or whether there will indeed prove to be an element of the nature of the "spark of life" of the ancients, transcending mortal understanding.

Of great interest in this connection are some recent experiments by a distinguished American physiologist, Dr. D. T. MacDougal, Director of the Carnegie Institution of Washington's Laboratories for Plant Physiology at Tucson, Arizona, and Carmel, California.

For many years Dr. MacDougal has been studying the phenomenon of life by a very rational method. He has chosen as his materials chemical substances of the same nature as those occurring in living matter, and has subjected them, singly and in combinations, to the various conditions to which living material itself is normally exposed. He has made elaborate studies of the action on these materials of certain physical processes believed to play important roles in life.

Such a process is that known as swelling, wherein certain semi-solid substances like gelatin, when immersed in water, will attract to themselves molecules of water which they hold with great force, with consequent increase in size. There is no doubt that swelling is an intimate associate of most life processes. Someone has suggested that the mechanism of muscle action is simply a matter of swelling and shrinkage of the muscle fibres. Dr. MacDougal has invented an instrument (shown on page 83) for making an automatic record of the swelling in liquids of gelatin plates or of sections cut from the living cactus plant.

It is now generally known that the unit of living matter is the cell. The cell is the building-stone—the brick—from which all plants and animals are constructed. Life may indeed be regarded as the resultant action of the cells of which the organism is composed. What more natural, then, than to concentrate attention on the single cell? There is little doubt that these microscopic objects hold the key to the full understanding of life.

Dr MacDougal has made a deep study of the known facts about cells. He has dealt particularly with plant cells, but that does not destroy the general character of his results. Viewed as a piece of architecture—as one would view a large building or the ground-plan of a town—the cell is a fairly simple affair. Figure 1 gives a general idea of the plant cell. It develops from a tiny mass of jelly, and the first change is perhaps a matter of self-protection—the outer layer of this ball of jelly undergoes a hardening process which forms it into a tough protecting sheath.

Most Primitive Plants Are Single Cells

As the cell enlarges, first by the addition of more material and then by absorption of water, the central portion becomes a hollow, water-filled cavity and the jelly-like protoplasm is pushed towards the outer wall to form the soft, semi-solid layer we call the plasma, or plasmatic layer. If now we place in the plasmatic layer a number of dark-colored bodies, the picture is complete. The simplest plants and animals—the ancestors of us all—consist of only one cell which under the microscope looks very much like this.

The natural sequel to Dr. MacDougal's series of researches on the chemistry of protoplasm was an attempt to construct a model of the living cell, of similar materials arranged in similar relations to each other as in the actual cell.

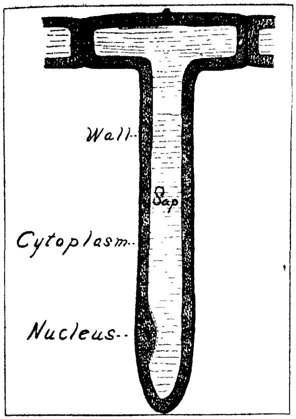
Much experimentation was necessary before the present model of the "artificial cell" was designed. Figure 2 shows this model. The framework on which the cell is built is a paper thimble about one inch in diameter and three inches high. This thimble, being pure cellulose, also serves admirably as the external cell-wall.

The first step in the imitation of the plant cell is the deposition within the meshwork of which the cellulose thimble consists, of substances of sugar-like composition and jelly-like consistency. Such substances are agar-agar, which is extracted from a kind of sea-weed and comes in crisp flakes like breakfast food, and pectin, a similar material found abundantly in apples. These substances are dissolved in boiling water to a thick, brownish syrup, into which the thimble is dipped. In order to obtain the desired physical structure, the thimble is now treated with alcohol, which abstracts part of the water. Next is prepared a solution of a mixture of gelatin and agar in proper proportions. To this is added a small quantity of some fat, a little soap, and a minute trace of salt. All these are included to represent actual conditions in plant protoplasm, which contains a very small amount of a great many substances. A layer of this hot mixture, a quarter of an inch thick, is applied to the inner surface of the thimble and allowed to harden, representing the plasmatic layer.

A rubber stopper carrying glass tubes is inserted in the thimble, and a solution of sugar is poured in to represent the cell sap. The "artificial cell" is now ready for operation.

What will it do? In general, it may be answered that this artificial cell will do a great many things that its living model does. If the cell, constructed as described and filled with sugar solution, is placed in a glass beaker containing either pure water or a solution of some salt, water alone or water plus particles of salt will pass through the cell wall and into the solution of sugar. If the cell was originally full of sugar solution, any further liquid passing into it will cause an overflow through the tube B (Figure 2), the amount of which overflow serves as a measure of the activity of the cell.

In the case of the living cell, much is known about



WHAT THE ARTIFICIAL CELL IMITATES

Figure 1. Schematic diagram of a root hair, the cell which protrudes from plant roots and absorbs plant food

its conduct in various salt solutions, what salts are allowed to enter and which kept out, and the speed at which each will act. Most of these facts have little rhyme or reason to them; that is, they do not seem to be explainable by the known laws of chemistry and physics. Thus, when the solution in which the cell is immersed contains certain pairs of salts, there is often a curious effect spoken of as antagonism, whereby the penetration of each salt is modified greatly by the presence of the other. This phenomenon of antagonism has been thought characteristic of protoplasm, and there is no known property of the constituents of the protoplasm or of the salts which accounts for it

In many such cases, Dr. MacDougal's artificial cell has proved itself to be a faithful reproduction of the living cell To the chemist this is a very striking thing, for it contains the insistent suggestion that this business of interference of ions, long a mystery, will ultimately prove to have a simple explanation in terms of chemistry and physics.

One specific case of this general sort, where the artificial cell imitates nature in an astonishing manner, is that concerning the absorption by plant cells of the two common elements, sodium and potassium. These two elements, in their various compounds, are among the most abundant substances in the world. From the chemical standpoint they are remarkable in the close similarity of all their characteristics. That means, in terms of the new science of atomic structure, that the atoms of these two metals have architectures as nearly alike as two floors of a skyscraper.

Sodium and potassium are, as would be expected, practically interchangeable in most experimental processes in which they take part One long-known and striking instance where they are quite different, however, is in their penetration into plant cells. Whereas theory would suggest that they would be about equally absorbed, experiment shows that, under comparable conditions, *sixty times* as much potassium as sodium is taken up and held by the cell. This goes absolutely against all chemical theory. About all we know about it is the repeated demonstration that it is so It has been often pointed to as a "property of life," or as due to the "selective action" of the cell, indicating that living processes are governed by laws entirely different from those holding in the realm of inanimate matter

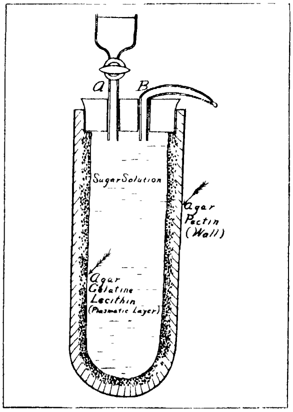
Artificial Cell a Practical Tool

Now comes the artificial cell, made in the laboratory, from materials as dead as a defeated presidential candidate, and having to the living cell only an approximate chemical similarity. On subjecting his cell to appropriate experiments, Dr. MacDougal discovered that about five times as much potassium as sodium was absorbed At first glance, one might be inclined to say that, after all, there's a big difference between sixty times and five times. Quite true, but the point is that chemistry finds itself at just as much of a loss to explain the five times as it does the sixty times Biologists who have worked with the artificial cell are convinced that once the true explanation is found for the five-fold deviation from the theory in this case, the same explanation will hold for the living cell.

No claim is made that observation in the artificial cell of processes previously thought peculiar to living matter, constitutes directly an explanation of these processes. In no sense is this so The importance of the artificial cell is as a tool which is infinitely easier to handle and work with than the minute living cell.

In our artificial cell, the chief initial difficulty is in the establishment of such a similarity between the actual living cell and its man-made model The author of the artificial cell makes no claim to perfect similarity. He knows quite well that his model is only a first short step. But he believes, and his evidence is convincing, that his artificial cell is so like the real cell that it will duplicate in principle certain actions which are very important for the understanding of life.

Our artificial cell will for a very short time take up food material and water, with coincident increase in size In other words it will *grow*. But unlike the real cell, it ceases to grow after a short time. To make it grow further, we must "wind it up" again, which means we must substitute new solutions for the spent ones Then growth proceeds for another short period, and again stops It has been demonstrated that, in this case, the cessation of growth is due to the cell system having reached what the chemist calls a point of equilibrium. That is, a state of balance has been produced.



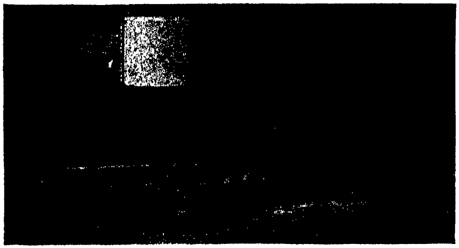
THE ARTIFICIAL PLANT CELL

Figure 2 This is not the actual artificial cell as it appears in the laboratory, but a schematic diagram

The process of cell action seems to be essentially a series of chemical reactions These are going on at different rates and in different directions This being so, it is inevitable that sooner or later everything must come to a standstill

The chief difference between the artificial cell and the living cell seems at present to be that in the former the intervention of man is necessary to "throw the switch"—that is, to upset the balance and start things going again—while the living cell is apparently provided with some unknown mechanism for doing this at the psychological moment.

It may be, indeed, that the really unique thing that characterizes a living cell as different from its man-made counterpart, is this mysterious device for pulling the trigger just at the right time.



DR. MACDOUGAL'S "AUXOGRAPH" RECORDS THE SWELLING OF PLANTS

Three sections of living plants are placed in the dish. As they swell, the vertical rod which bears on them actuates the lever and the clock-driven recorder, which gives a permanent record of the amount and time of growth

THE SEVERAL INGREDIENTS USED TO MAKE UP THE ARTIFICIAL PLANT CELL

At the left is the complete artificial cell, set up On the right of it are the various materials which make up its physical structure The glassware device shown near the extreme right is a part of the artificial cell shown at left

Our Point of View

Coolidge Aircraft Board Report

OF the various Boards that have already reported upon the subject of aviation, the first place in importance is taken by the Aircraft Board, which was selected by the President and is composed of nine men, military and civil, of national note and carrying a high reputation in their particular spheres of activity The report is unanimous, judicial, and devoid of sensational statements Although it recommends no such complete overhauling of the air service as Colonel Mitchell would like to see, its suggestions are highly constructive and, it seems to us, are well suited to meet the problems of aviation in the United States, whether civil or military The proposals of Colonel Mitchell and his supporters are stated to be either exaggerated, or without foundation, and the proposal to create a unified air service, and the plan of amalgamating the Army and the Navy in a department of national defense, with an air branch, is rejected The report recommends the creation of an additional assistant secretaryship dealing with their respective aircraft activities, in the Departments of War, Navy and Commerce It believes that this would result in a better solution of aircraft problems and open the way for a more satisfactory advancement for Army and Navy fliers

The Board believes that, because we are so well protected geographically, a large air force is not necessary to the defense of the territory of the United States, but that the development of the use of civilian aircraft should be encouraged by creating a bureau of air navigation in the Department of Commerce under an additional assistant secretary. The fear of attack by a potential enemy of menacing strength is stated to be unreasonable. The strength of the air army in proportion to the general military establishment compares favorably, we are told, with that of any other power Our Army and Navy personnel is found to be of the very highest type.

The report commends itself to us as meeting the problems of the present air situation in a reasonable and thoroughly constructive manner We are decidedly of the opinion that the best way to build up our air defense is to encourage civilian aviation by passing the long delayed laws which are so essential to its development.

In this connection, it is in place to refer to the verdict in the Mitchell court martial Unlike the inquiry by the President's Board, this investigation had to do with discipline and conduct He was found guilty of violating the Ninety-sixth Article of War. His criticisms of his superior officers amounted to insubordination, and his conduct was found to be prejudicial to military discipline. A strict rendering of the law would call for his dismissal but because of his fine record in the war, he is merely suspended for a period of five years

Fire Perils at Sea

THAT fire risk at sea is a fearful and ever-present peril has been shown by several recent disasters to coastwise freight-and-passenger ships They prove that, though provision against foundering has made great strides; prevention of loss by fire, at least in these mixed freight-and-passenger ships, lags far behind The Steamboat Inspection Service, although it calls for fire-detecting apparatus, does not go so far as it should in demanding adequate provision in the holds for immediately putting out a fire, once it has been discovered Another, to us, astonishing fact is that the ship classification societies make no demand for adequate fire protection. Hence, we are not surprised that while losses through foundering are decreasing, those due to fire are relatively on the increase

Now, for the protection of their ships and passengers, the owners of the large Atlantic liners have voluntarily equipped their vessels with a system which instantly notifies the bridge if a fire starts in a hold and, also instantly, smothers the fire by flooding the hold with live steam or other active retardant The holds, it is needless to say, are so constructed as to be, if we may use the term, fire-tight.

The Sacrificial Pool of the Maya Indian Maidens

The picture on the opposite page shows the ghoulish cenote of sacrifice at Chichen Itza, the capital of the ancient Mayan empire. The cenote was venerated throughout Central America by the Mayas as the Holy of Holies. In its dark, deep pool, hundreds of young Indian maidens were sacrificed to the god of rain, says tradition.

That this unhappy tradition is true has now been proved by dredging in the deep mud at the bottom of the pool, from which innumerable bones of skeletons have been recovered.

The Castillo shown elsewhere in the picture was the principal temple, and from it the unfortunate maidens were led down the processional way with accompanying music, to the sacrifice.

Other features of the city of Chichen Itza are shown as they recently appeared when the thick brush with which the site was overrun had been partly cleared by Dr. Thomas Gann's recent expedition. Many of the buildings have yet to be uncovered.

The fire-prevention system that is installed on the "crack" liners includes means both for detecting a fire and for quickly putting it out. Each hold is an entirely separate structure, with bulkheads, decks, and overhead casing of steel, and capable of being entirely shut off from the rest of the ship. From the top of each hold a small smoke pipe leads to a cabinet on the bridge, where it vents to the air, means being provided to induce a slight exhaust suction. Individual steam pipes lead from the boiler room to the holds. Immediately, upon seeing smoke issuing from a tube, the officer on the bridge can turn steam into the corresponding hold, quickly extinguishing the fire. Another protection which should be applied to all passenger accommodation is the provision of steel fire-bulkheads, extending clear across the long row of staterooms, at stated intervals, and provided with fire-tight doors across the alleyways.

The classification rules of the insurance companies and the requirements of the Steamboat Inspection Service should be modified to make *all* passenger-carrying, ocean-going ships in coastal service provide both fire-detection and fire-extinction construction and apparatus, before they receive either insurance or the Steamboat Inspection Service sanctions.

The most elementary humanitarian considerations demand this, it was due to sheer good luck as to weather and location, coupled with the discipline of the crew and the self control of the passengers, that two shiploads of passengers were not wiped out by fire in the recent disasters. Had the ships been upon the transatlantic route and far from land, the fire which swept through the inflammable staterooms would have driven the passengers to the boats and left them at the mercy of wind and sea.

Is Science Callow?

WHAT science needs most today is a true vision rising above spectrometers, cell walls, vapor tensions, microtomes and polarities, and seeing beyond them—as far as man can hope to see—the end toward which all these humbler things are but little steps.

Such a vision is that of Professor Theodore D. A. Cockerell of the University of Colorado—biologist, zoologist, entomologist of note, but known, because of his writings, to all the biological world as "the Huxley of America", a man who has made of a little corner of science a true philosophy, who has brought to those who care more for life itself than for a test-tube full of green precipitate, a foreshadow of what science, under better guidance than that of our day, might mean to the "man in the street."

Concerning the higher beliefs of the true scientist, Professor Cockerell says:

"The scientific man spends his life trying to discern the workings of the Law, in order that thought and deed may conform to Nature's harmony. The more he investigates, the more sure he becomes that order prevails, and that there are no supernatural phenomena, nor ever have been. But we must hasten to add that he knows full well that only part of Nature is or can be revealed to him, and that beyond what he knows as science, is a vast realm at present beyond the reach of experiment."

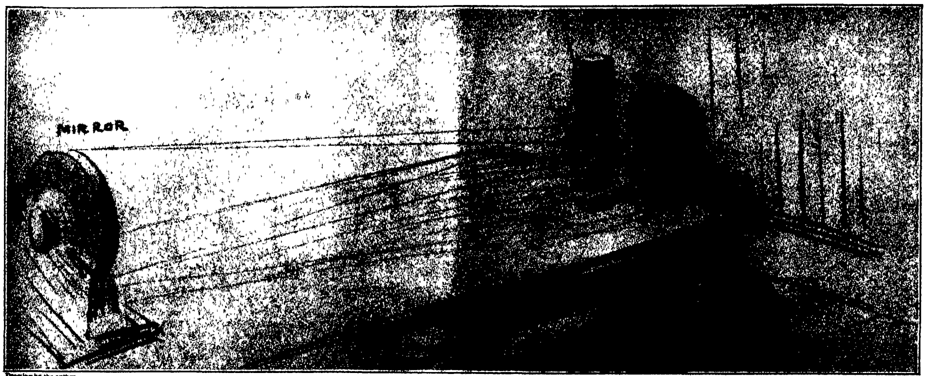
"This," continues Professor Cockerell, "is why Alfred R. Wallace, one of the greatest naturalists of modern times, wrote in his ninetieth year that the attempt to solve Nature's problems had given him, during his long life, an ever growing sense of mystery and awe."

And to us Professor Cockerell sends the following lines, which he conceives as if they were a fragment from a play:

"O, every girl, within your breast a beating heart
Records the pulse of Nature, has its part
In the great order of the circling suns
For all creation's one, a single purpose runs
Through warp and woof of time and space,
And you, and we, with steady mind must face
The thing that is, *and learn to love its laws.*
Thus may our *work* be fruitful and repay
The labor patiently bestowed from day to day.
Thus may we join in Nature's greater plan,
Unfolding through the ages since the world began.
Thus *health* becomes our friend, as we obey
The ancient laws of life, and search alway
To do her bidding.
Yea, not even Love
Dares scorn the fruit of knowledge, for above,
Within, without, must order reign supreme,
And law, unchanging, rules love's golden dream."

Professor Cockerell has been invited to write for the Scientific American, and he will doubtless show us that what we need is more natural religion in science.

Drawn by S. W. Clatworthy from details supplied by Dr. Thomas Gann

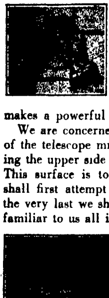


Drawing by the author

FIGURE 1. HOW THE KNIFE-EDGE TEST IS MADE. THE SIMPLEST EQUIPMENT SERVES AS WELL AS THE MOST COMPLICATED
Light from the pinhole, P, is reflected into the eye. The interposition of the knife-edge produces shadows on the mirror like the shadowgraphs at top of pages 88-89

Mirror Making for Reflecting Telescopes

By Russell W. Porter, M.S.
Optical Associate, Jones and Lamson Machine Company



IN the reflecting telescope, *the mirror's the thing.* No matter how elaborate and accurate the rest of the instrument, if it has a poor mirror, it is hopeless. Conversely, a good mirror, even if it is crudely and simply mounted, makes a powerful and efficient astronomical tool.

We are concerned in this article with the shaping of the telescope mirror. This consists solely in giving the upper side of it a concave, polished surface. This surface is to be so nearly spherical that we shall first attempt to make it precisely so; and at the very last we shall alter it to the kind of surface familiar to us all in automobile headlight reflectors, and known among the highbrows as a paraboloid of revolution.

Such an automobile headlight has the property of throwing out from a concentrated source of light placed at a focal point near it, a beam of parallel rays. (See Figure 6.) We shall, however, use this reflector the other way around, that is, by receiving parallel rays of light from a distant object (star), and by reflecting them from a properly curved mirror we shall bring them to a point or focus (F, Figure 6).

Our curve, however, is so small a portion of this widely sweeping parabola (the black area represents the mirror) that it is extremely shallow, and so it nearly coincides with the superimposed spherical curve. At first, therefore, we shall seek to hollow out a spherical curve, later deepening it very slightly into the paraboloid.

Since the angle of incidence of a reflected beam of light is equal to the angle of reflection, the parallel, arriving rays will be reflected approximately to a focus whose length may be regarded as one-half of the radius of curvature, C-A, Figure 6.

Enlarging the mirror of Figure 6, A, we have in Figure 8 the essentials of the Newtonian, reflecting telescope. Light from a distant object falls down the tube to the mirror, and normally would, by reflection, produce an image at the focus, F. The converging rays are, however, intercepted at D by a small diagonal mirror or prism that delivers them to a lens called an eye-piece at the side of the tube, where the image is examined.

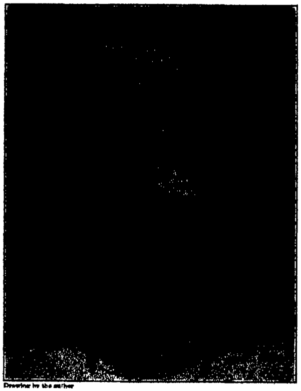
I will take as our standard, a mirror six inches in diameter, having a four-foot focal length. The beginner is not advised to essay a larger mirror for his first effort, since his difficulties will be found to multiply quite disproportionately as the diameter increases. If two flat glass disks (A, Figure 7) are ground together, one over the other, with an abrasive between, lo and behold!—the upper one becomes concave, the lower one convex. This is because the center receives constant wear, while the outer portions, overhanging part of the time, receive less wear.

A straight, back-and-forth stroke, in which a given point on the upper disk moves across one-third the diameter of the lower, has the property of holding the two surfaces spherical. This is due to the fact that spherical surfaces are the only ones which remain in continuous contact at every point when moved over each other in any direction. This fact is a veritable godsend to the amateur—and to the professional, too, for that matter—for he may go confidently forward through the different stages of grinding and polishing with the knowledge that his mirror will come out nearly as it will be when it is finally deepened into a paraboloid.

The depth of the curve increases with grinding, and is gaged with a template of proper radius. Since by our rule, the radius, A-C, Figure 6, of the

Drawing by the author

FIGURE 2 THE AMATEUR AT WORK
The best place to work is the cellar, where the temperature is reasonably constant, an essential condition



Drawing by the author

FIGURE 3: THE FOUCAULT, KNIFE-EDGE TEST
With a lamp and razor blade, imperfections of the order of a millionth of an inch can be detected

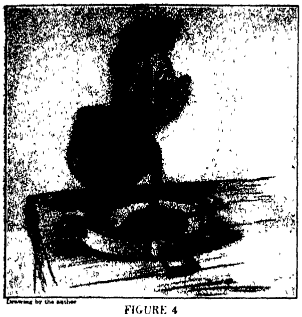

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FIGURE 4

Preparing the pitch lap, or polisher

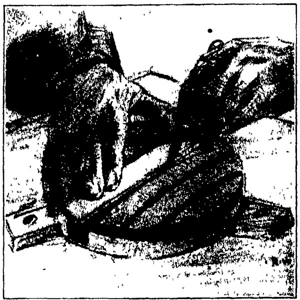

Drawing by the author

FIGURE 5

Cutting channels in the pitch lap

curve of the glass is twice its focal length A-F, a template is made from tin, with a radius of twice 48 inches, or 96 inches. Therefore a stick of wood (not a string, which would be elastic) should be tacked to the floor at one end so as to pivot, and a knife point held at the opposite end, or a sharpened nail driven through at the proper distance, should be used to scratch the desired curve to which the tin should be cut. For our six-inch mirror the hollow will come to about .05 inch deep.

The lower disk of glass is fastened to a pedestal or to a weighted barrel so that one can walk around it in grinding, or it may be held between one removable and two fixed buttons on the corner of a stout bench or table (See Figure 2) Using melted pitch, a round handle is attached to the upper disk, which is first heated in cold water to a slightly unpleasant warmth for the hand, taking care that no cold water drops fall on the warmed disk, for they might break it.

The grinding is done by placing wet carborundum grains of successively finer sizes between the two disks, care being taken after each size is used to wash all parts of the work entirely free of the larger sized grains, which would otherwise scratch the disk. The strokes are straight forward and back, the center of one disk crossing that of the other. The glass also rotates bit by bit in the hands, in order to present a new direction for each stroke; and from time to time, in order to prevent the wearing of the glass unsymmetrically, the worker shifts positions around the pedestal; or, if working on a bench, he turns the lower disk, called the "tool" (we shall discard this tool at the end) to a new position.

Each grade of abrasive is used long enough to remove the coarser pits left by the preceding grade, and it will save much time and labor in the polishing if a small quantity of washed 6F ("sixty minute") emery is used after the Number 600 carborundum.

All the preceding work is covered in great detail by Ellison in his book, "The Amateur's Telescope," which at the present time is the only modern book of this nature available. [Editor's note: See list of literature and materials, prepared by Mr. Porter and printed in the Digest department of the present issue.]

The bench and both disks are now thoroughly washed in order to remove all traces of grit, preparatory to polishing.

Pitch is melted over a stove. It is tempered by adding (not over the fire) sufficient turpentine until a cooled sample placed between the teeth will just "give" slowly without crumbling, or will show a slight indentation of the thumb-nail under moderate pressure. The pitch is poured (Figure 4) over the tool, which has been warmed in water, and dried, and when it is partly cool, the glass is wetted (in warm water) and pressed down on the pitch until perfect contact is obtained between glass and pitch. V-shaped channels an inch apart are now cut across the pitch at right angles to each other, to allow free access of the rouge and water to all parts of the glass. Do not center this system of channels or you may produce zones in the mirror. See Figure 11

Rouge mixed with water is now substituted for the carborundum and the polishing is carried on to completion, using the same strokes as in grinding. The time thus far consumed in grinding should be about five hours; polishing may require nine hours, divided into "spells." Through all these operations Ellison, the author of "The Amateur's Telescope," goes with painstaking care, anticipating the pitfalls into which the tyro inevitably falls. Were I to emphasize one caution over another, it would be the care required in preserving complete contact between the glass and the pitch lap surfaces while polishing

If one-third strokes have been maintained in grinding and polishing, the surface of the glass will be nearly spherical. How shall we find out? The method I shall now describe is one of the most delicate and beautiful tests to be found in the realm of physics. By it, imperfections of a millionth of an inch on the glass can be detected, and all the tools required are a kerosene lamp and a safety razor blade! This method of testing mirrors, called the Foucault knife-edge test, was unknown until about 1850, before that time mirror makers were groping in the dark. Even the great Herschel—father of the reflecting telescope—did not know when his mirrors were right, except by taking them out and trying them on a star.

If an artificial star made by a tiny pinhole (use a needle point) in a tin chimney on a kerosene lamp (an electric lamp will not be suitable) were placed at the center of the sphere of which the mirror's curve is a very small part, all of that portion of the light that emerges from the pinhole and strikes the mirror, is reflected back to the pinhole; for these light rays are all radii of the sphere, and by reflection they must return as radii back to their source, the pinhole.

In practice, the pinhole is pushed over a little to the right of the center of curvature so that the cone of reflected light may clear the chimney and enter the eye, as shown in Figures 1, 3 and 9. The mirror is placed on its edge on some suitable support, at table height, in a fairly darkened room The lamp

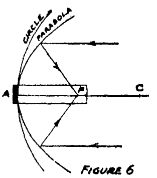


FIGURE 6

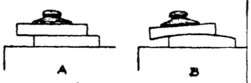


FIGURE 7

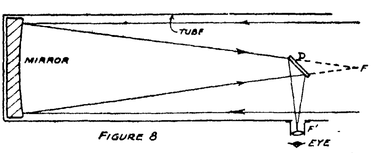


FIGURE 8

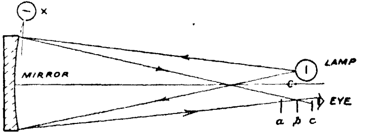


FIGURE 9

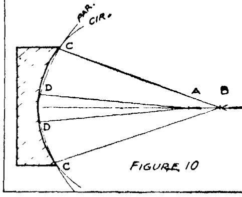


FIGURE 10

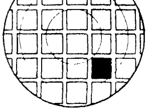
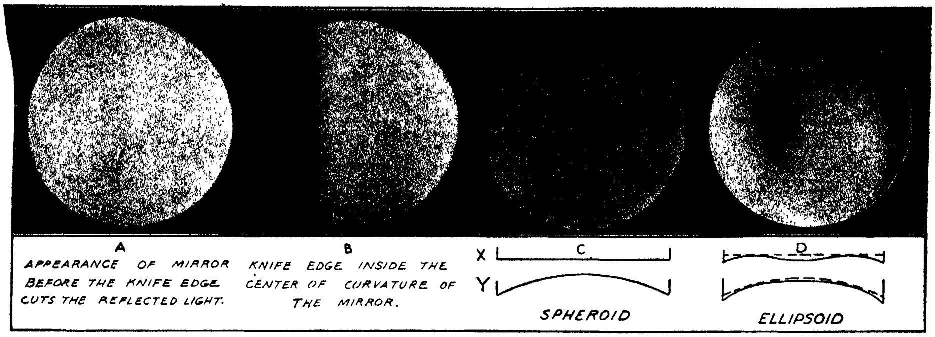


FIGURE 11

Drawings by the author


A
APPEARANCE OF MIRROR BEFORE THE KNIFE EDGE CUTS THE REFLECTED LIGHT.
B
KNIFE EDGE INSIDE THE CENTER OF CURVATURE OF THE MIRROR.
X
C
Y
SPHEROID
D
ELLIPSOID

and the knife-edge (mounted on a block of wood) are placed on a table as shown, and about eight feet from the mirror, viz., at its center of curvature

At first, considerable difficulty may be encountered in picking up with the eye the reflected cone of light One way is to replace the tin chimney with a glass one, walk away from the lamp, keeping it in line with the mirror, when the image of the lamp will be seen in the mirror itself Then bring the eye forward slowly, keeping the lamp image in view, and move the knife-edge to the right until it cuts off half of the image The tin chimney is then put on and the image of the pinhole may be picked up somewhere near the edge of the safety razor blade. An alternate method is to use a piece of ground glass, which can be prepared by rubbing it with carborundum, to explore the neighborhood of the lamp, picking up the bright spot of light on it As the eye approaches the position shown in the figures, this pinhole image begins to expand until a position is reached where the mirror is flooded with light over its entire surface—almost dazzling (See shadowgraph A, above)

Now comes the remarkable knife-edge test. The razor blade is moved in from the left until it cuts into the reflected cone of rays If at a, Figure 9, that is, *inside* of the center of curvature, a shadow will come in on the mirror from the left, as might be expected (shadowgraph B) If however, it cuts the rays at c, Figure 9, that is, *outside* the center of curvature, the shadow will advance over the mirror from the right, giving an appearance the reverse of shadowgraph B (or as B appears with the page turned upside down) But *at* the center of curvature, b, the mirror, if spherical, darkens simultaneously over its entire surface, becomes evenly gray (like shadowgraph C), and as the knife-edge is moved farther, it quickly vanishes. This is the simple test for a spherical surface, but it would be sheer luck if one's mirror appeared thus at the first test

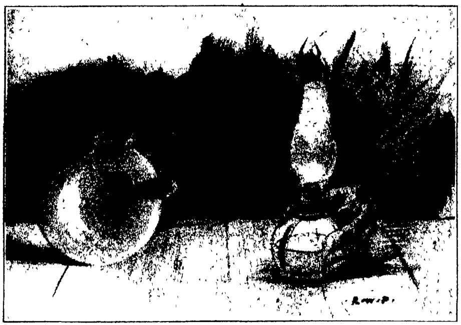
Viewed as just described, the surface of the curved mirror does not seem curved, but has the strange illusion of being flat. The observer *knows* it actually has a section like Y, under shadowgraph C, but it *appears* flat, like apparent section X, same place.

The surface having been brought to a sufficiently fine polish and to a spherical curve, the remaining work on the mirror, known as the "figuring," consists in slightly deepening this spherical surface into a paraboloidal surface, and this is done by polishing away the center faster than the edge. The final goal is to make the mirror appear, when the razor blade is beginning to cut off the light, like the shadowgraph E, F, or some intermediate depth, depending on the focal length, which need not be exact.

A common imperfection will be a raised or depressed zone, appearing like G and H in the shadowgraphs, whose true (lower) and apparent (upper) sections are shown beneath them In the case of the raised zone the shadow has all the reality of a flat surface on which is a raised portion in the shape of a ring, the left slopes a, a, shadowgraph G, being in shade, the right slopes b, b, being in the light, *as though* the mirror were illuminated by a lamp placed on the opposite side of the glass from the knife-edge, as at X, in Figure 9 Figure 12 is an attempt to show how this imaginary lighting, at grazing incidence, *would* produce these shadows. Here the shadow of the man's fingers is superposed over the knife edge shadow of a paraboloid. Conversely, a depressed zone (shadowgraph H) will have its lights and shades reversed.

Other characteristic shadowgraphs shown indicate curved surfaces well known to geometers under mouth-filling names I would refrain from repeating them here for fear of throwing the novice into a panic of discouragement, but they must, nevertheless, be labeled for purposes of identification. Perhaps it will refresh the student's memory to note again the relations of these curves as shown in conic sections (Figure 14).

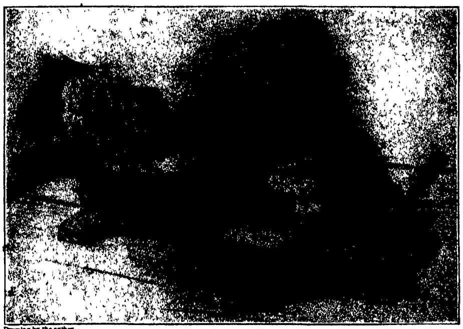
We have already considered the sphere whose section gives a circle (near top of cone, Figure 11) Its neighbors above (unlabeled) and below are the ellipsoid whose shadowgraph, shown at D of the shadowgraph series, presents a raised center and edge The next curve is the parabola, its corresponding surface being the paraboloid, having an appearance the reverse of the ellipsoid, that is, an



Drawing by the author

FIGURE 12 AN EFFORT TO EXPLAIN THE ILLUSION OF THE SHADOWS

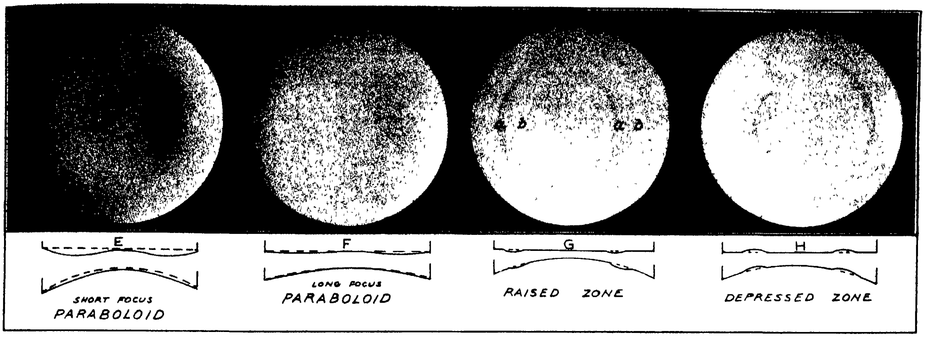
The real source of light in the shadow test is the pinhole in front of the mirror, the mirror appears, however, as though illuminated from one side, grazingly



Drawing by the author

FIGURE 13· FIGURING THE MIRROR IS THE MOST CAREFUL WORK OF ALL

One method of figuring, or wearing away certain areas of the glass which the knife-edge test indicates are too high, is by the overhanging, elliptical stroke



apparently depressed center and edge, like a "Life Saver" candy with its central hole filled in. *This is the surface of a perfect telescope mirror.*

A paraboloidal mirror of short focus gives the stronger shade (shadowgraph E), a mirror of long focus gives a fainter shade (shadowgraph F). Our mirror, with focal length approximately six times its diameter, is about intermediate. The hyperboloid, corresponding to the hyperbola (Figure 14) is not shown in any of the shadowgraphs, its shadows are those of an exaggerated paraboloid, that is, quite dark, with the crest of the raised area nearer the edge of the mirror.

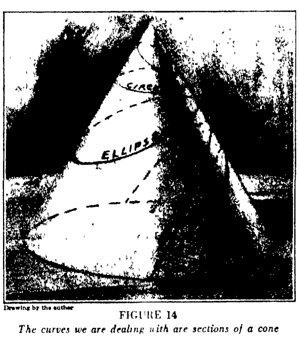
There is something uncanny about these shadows and shadowgraphs. As before mentioned, they should all be interpreted *as though* illuminated by light coming in from the right. But if one can force one's self to imagine these shadows as produced by light coming from the left, they will give an impression exactly the obverse. For example, in the case of the zone (shadowgraph G), one can change its appearance from a bas-relief to an intaglio, like shadowgraph H, by imagining it lighted from the left; and with a little experience one can make it perform in either manner at will. The rule is to consider the light coming from a direction opposite to the knife-edge. Ellison is almost unique among mirror workers in placing the light on the left and the knife-edge on the right.

Now all of these possible surfaces into which one's mirror may develop, are to be treated in the same way—the apparently raised portions are worn down to an apparently flat surface. There are several ways of accomplishing this result and all are described by Ellison in his book, at greater length than the present space could possibly permit. In general, a zone may be reduced by removing a part of the pitch lap, for it is evident that a square of pitch removed as shown in Figure 11 would tend to raise a zone on the mirror. The danger here is in producing unexpected zones, and the drawback of having to remake the lap (always a fussy job) if the altered pitch fails to correct the glass. Suffice it to say that, as explained in Ellison's book, there are several strokes and positions of the glass overhanging the tool that will bring almost any surface to that of the desired sphere, ready for the slight deepening into a paraboloid, without changing the lap.

This is the hardest, but at the same time the most fascinating, part of mirror making. Any one of these surfaces is so close to the sphere that no mechanical means could detect a difference between them. And yet, under the knife-edge, each type stands out glaringly with its own characteristic shadow—never to be forgotten when once seen.

Let us now assume that the mirror has been brought spherical—that it appears flat, under test. The curve now to be sought belongs to type E, F (shadowgraphs). This is very close to the sphere—so close that but a few moments polishing with a long stroke, or by letting the glass overhang the tool sidewise, will produce it. *Frequent testing is therefore essential during this crucial work of figuring the mirror.*

In Figure 10, the two curves represent sections of a sphere and of a paraboloid. It is evident that the parabolic curve is flatter at the margins, C, C, of the glass than at the central portion, D-D. Therefore light reflected from the pinhole will bring the rays from C and C to a point at B, on the axis of the mirror, further away than the point where the deeper part of the curve, D D will focus them.



Drawing by the author

FIGURE 14

The curves we are dealing with are sections of a cone

The distance between A and B is given from the equation, AB equals the square of the radius of the mirror, divided by its radius of curvature. Substituting for our six-inch mirror of four-foot focal length, we have, AB equals $(3)^2$ divided by 96, or 9/96, which is about one tenth of an inch.

We now diaphragm out all of the mirror except a half-inch around the margin, and mark on the table the position of the knife-edge when the light darkens equally over the exposed portions. All of the mirror is then covered except a central portion two inches in diameter, and the knife-edge test is again applied similarly. This time, if the surface is correctly parabolized, we shall have to move the knife-edge toward the mirror one-tenth of an inch, as above determined. In both of the above tests, what we are really doing is to select limited parts of the parabola and regard each part as locally spherical, and then determine the degree of parabolization by ascertaining the difference in focal length of the respective spheres.

Silvering is now in order. The Bureau of Standards at Washington will provide, for the asking, a pamphlet describing the silvering process—how the glass is properly cleaned, the necessary chemicals and how they are used. Ellison also gives directions for silvering. It was some time before I produced a good, tough, silver coating, but if I had had access to the pamphlet referred to, there would have been no trouble.

Finally, if a lacquer (see appendix in Digest department), diluted six times with amyl acetate, is poured over the mirror and allowed to dry with the glass on its edge, the lustre of the silver will be prolonged for years, without in any way impairing its optical properties.

Nothing has been said here about scratches, effects of changed temperature on the glass, where best to work, testing with an eye-piece, testing at the focus, the dreaded turned-down edge, sticking of the glass, the various strokes and altered laps, and so on. Ellison covers them all.

Sir Howard Grubb, the well-known English maker of telescopes, is credited with the remark that "when the mirror has been brought to a complete polish, the work is about one-quarter done." And while it is true that the long interval of figuring with its interminable testing, tries the soul of the amateur, let him take pride in the fact that he is dealing with—and controlling—minute errors a thousand times smaller than those dealt with by a mechanic or machinist, and in the satisfaction of knowing that with this mirror made with his two hands he will be able to see the polar caps of Mars, Jupiter's bands, Saturn's rings, nebulæ, clusters and double stars—an instrument that would have excited the envy of even Galileo and Newton.

My experience has been this, that anyone who can use his hands, is possessed of moderate patience and sufficient reasoning ability to interpret the knife-edge shadows, can make a good mirror. Without these attributes he had better forego the venture.

Mirror making has many points to commend it. The tools are easy to make. The cost of materials is (compared to results) low. The work may be carried on at odd moments, day or night and in any available room of the home. In short, it contains the elements of a real indoor sport.

¶ *Next month Mr. Porter will describe a number of mountings suitable for the amateur's telescope.*

Girdling the Earth With a Radio Beam

Marconi's Invisible Shaft to Encircle the Empire on Which the Sun Never Sets

By Orrin E. Dunlap, Jr.

THE various colonies of the British Empire are being linked by Marconi's latest development, the short-wave beam transmitter, which concentrates radio energy as a searchlight reflects light in a definite and desired direction.

Finishing touches on installations of this up-to-date system are being made near Montreal, by the Marconi Wireless Telegraph Company of Canada, for direct communication with England and Australia. The transmitters are located at Drummondville, forty-five miles east of Montreal and the receiving stations are at Yamachiche, approximately the same distance from Montreal, but twenty-five miles north of Drummondville.

These Canadian beams will be the first links to be forged in the world-wide, imperial wireless net. An agreement made with the British Postmaster General on July 28, 1924, provided that the Canadian Marconi Company should construct a beam station in the Dominion for communication with stations to be built in England by the Marconi Company as contractors for the British Post Office. The definition of a beam contained in that agreement is that the sending and receiving stations are capable of working simultaneously, the sending station to have an input power of at least twenty kilowatts, with an aerial system so designed as to concentrate the emitted waves with an angle of thirty degrees, and the receiving section to have a similar antenna system designed to focus the waves at the receiving end. In England, both transmitting and receiving stations are to be capable of operation at the Central Telegraph office in London by means of remote control, and in Montreal, remote control will be used from the office of the Canadian Marconi Company. Each station is to be capable of communication at a speed of 100-five-letter words per minute each way, during a daily average of eighteen hours.

Kadel & Herbert

MARCONI'S REVOLVING BEAM PILOTS SHIPS

On the lower frame of this revolving structure can be seen the contact plates or the make and break mechanism. The plates represent Morse characters and as the ring on which they are carried revolves and passes the contact breaker, signals corresponding to the Morse code are broadcast

New System Concentrates Energy

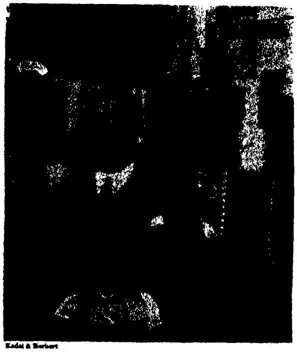
The Australian Government, through its operating company, the Amalgamated Wireless (Australasia) Limited, has contracted with the Marconi Company for the erection in Australia of two beam stations for high-speed service. It is planned to have one transmitter communicate direct with London and the other direct with Montreal. The stations will be designed and equipped for maintaining communication twenty four hours daily throughout the year and for duplex operation with both countries at high speed. It is expected that these stations will be open to handle public messages by March, 1926.

Plans are also under way for the installation of beam stations in India and South Africa for contact with London.

Marconi has pointed out that a tremendous waste of power occurs in the modern transatlantic commercial stations, which he believes are destined to be scrapped and replaced by the short-wave beam installations. The ability of the new system to concentrate energy saves electrical power and makes the method far more economical than the present high-frequency alternator or vacuum-tube installations, which radiate waves to all points of the compass.

Marconi, in his inaugural address as president of the Royal Society of Arts in London, said, "Most people may now agree with me that wireless waves are far too valuable to be broadcast in all directions, especially when it is desired to communicate only with one particular place, and I do not understand why, for example, messages which may be intended for Canada or South Africa should be scattered simultaneously, pretty well over all the rest of the world. I can well understand the utility of the non-directional stations for many naval and marine purposes, and of course for broadcasting; but for ordinary efficient communication between fixed places, or between one country and another, I think the right and logical thing to do, if possible, from the point of view of secrecy and economy, is to concentrate all the radiated energy into a beam directed toward the country or place with which it is desired to communicate.

"The number of available wavelengths is very far from being unlimited; and if a wavelength which is



Kadel & Herbert

SENATORE MARCONI IN THE RADIO ROOM

The inventor of wireless for the past ten years has been devoting his energies to the development of the beam system of transmission and reception. With the assistance of C. S. Franklin, experiments using the reflector method, with very short wave lengths, were carried to a successful conclusion

MAIN DISTRIBUTION SWITCHBOARD

This control board guides the current of the beam transmitters at Drummondville

Kadel & Herbert

INTERIOR VIEW OF THE POWER PLANT

These generators supply the energy for the Marconi beam at Dorchester, England

being utilized for communication between England and India is allowed to spread to Africa and America, it would most probably interfere with the free use of that wave in these countries."

Senator Marconi explained that, while the limitation of the working period of a beam to practically the hours of darkness constituted an undoubted disadvantage, still the economical advantages, together with the reliability and possibility of working this system at much greater speeds than would be feasible with present high-power, long-wave installations, went far to convince him of its practicability.

"Results of experiments," said Marconi, "have fully confirmed my expectations in regard to the behavior of the various wavelengths over great distances. I have no doubt that the information gained will render possible the installation of comparatively low-power stations capable of establishing and maintaining commercial services by day and night between England and the most distant parts of the globe. The low cost of this system, both in capital and running expenses, compared with that of the existing type of stations, must prove to be very great, and should bring about the possibility of reduction in telegraph rates for all long-distance communication, besides making direct communication with smaller outposts of the Empire remunerative.

"Already the size and power of some of the most modern long-wave stations is becoming a serious financial problem. The newly equipped station at Buenos Aires, for example, was designed primarily for communication with Europe over a distance of about 6,000 miles. It employs 800 kilowatts and an aerial supported by ten towers, each 680 feet high. This station usually works on wavelengths of about 12,000 and 16,000 meters. Another example is the British Post Office station located at Rugby, which employs 1,000 kilowatts and an aerial supported by sixteen towers, each 820 feet high."

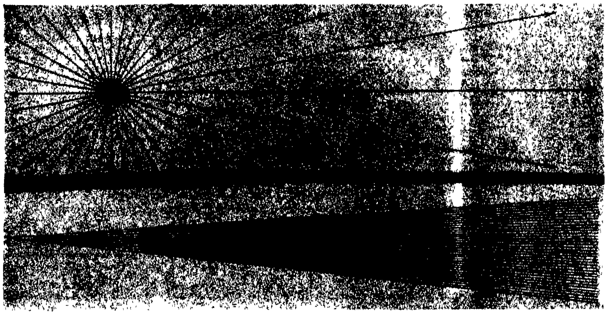
Radio Beacon Guides Ships

A ten-kilowatt beam station projecting its radiation in a narrow ten-degree band becomes, so far as a distant receiver is concerned, the equivalent of a 360-kilowatt transmitter, radiating broadcasts in all directions. The engineers explain that the possibilities of concentration do not end here. A similar reflector can be used at the receiver, whereby energy can be drawn from a wide area of the advancing wave front and concentrated on the receiver, giving a further increase in the total power intercepted.

Due to the size of the reflector which, for a given degree of concentration, increases with the square of the wavelength employed, the system is more adaptable to short waves, up to 150 meters. It is estimated that it will be possible to handle more traffic during two hours with one of these short-wave beams between Australia and London than could be disposed of by a 1,000 kilowatt broadcasting plant during twenty-four hours.

The masts of the beam transmitters are arranged in a straight line at right angles to the direction in which communication is to be established. The aerial and reflector consist of a number of vertical wires suspended from triatics attached to crossarms of the masts.

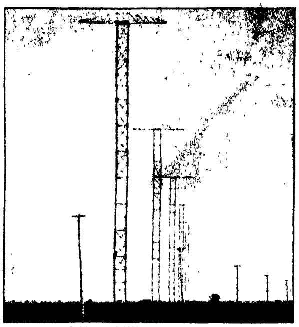
Senator Marconi has also developed a special application of the beam system in the form of a radio beacon for the purpose of guiding ships. Signals are projected in a narrow beam and a different Morse letter is flashed as the beam points to different points of the compass. The observing officer on the vessel listens in and hears a series of Morse characters as the beam sweeps slowly past the ship. The letters he hears tell him by reference to a chart the direction the beam is pointing at any given instant, and therefore, the middle letter of the series of letters he detects gives him his exact position. The signals are radiated on the six-meter wavelength. The cost of the receiving apparatus is low and consequently the system is brought within reach of all ships, even tugs and trawlers. One of these stations, which works automatically, is located at South Foreland, England.



Courtesy of Marconi Wireless Telegraph Company of Canada

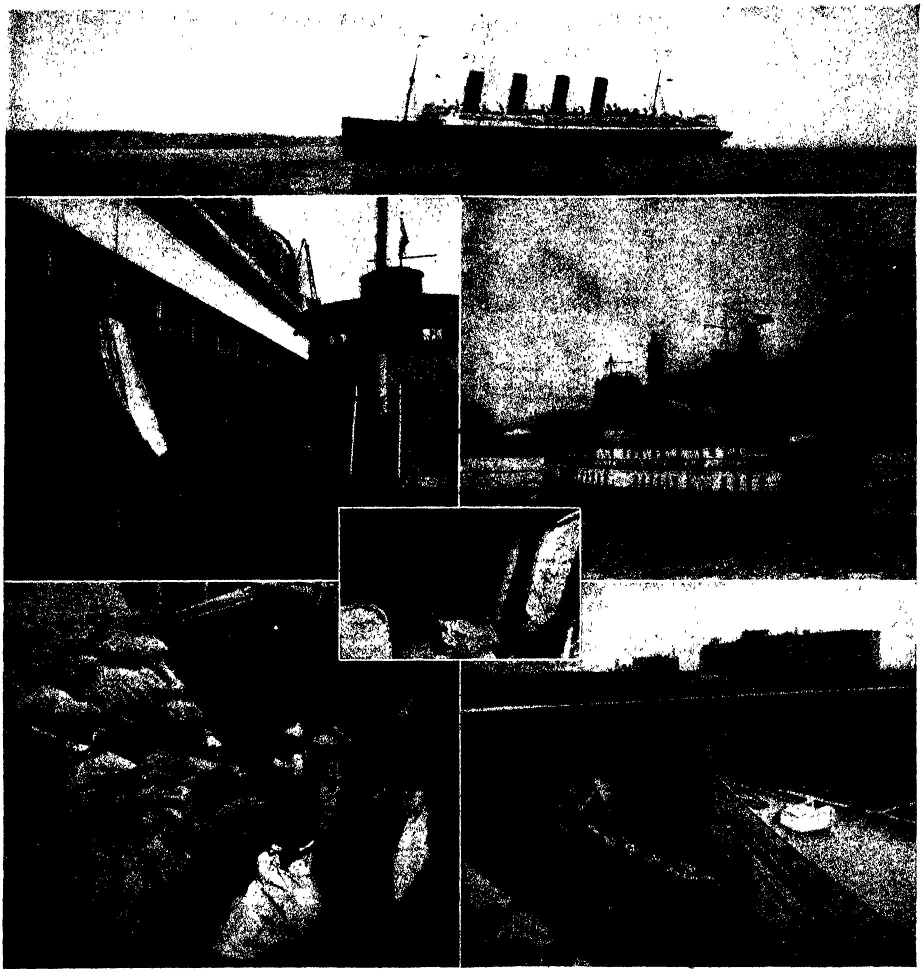
COMPARISON OF A BROADCAST TRANSMITTER WITH A BEAM

The top diagram illustrates how the ordinary transmitting station radiates energy in all directions. The lower illustration shows a transmitter radiating a beam of 10 degrees. Note how the use of a reflector concentrates the energy uniformly in a narrow angle. If the distant receiving station lies within the arc of that angle, it will intercept more than 36 times more power than it would if the same energy were radiated uniformly throughout the 360 degrees of a circle



THE MAST LINE AT YAMACHICHE

These towers support the receiving and reflecting aerials for reception of waves from England. The towers are similar in construction to the masts at Drummondville used for transmission to England



Neptune and the Postman

No stress of weather ever prevents the Mail Boat Service from taking off foreign mail from incoming ships in New York Harbor Day and night, everyday in the year, the staunch little fleet is ready to take off from one to fourteen thousand bags of mail. The idea is that the mail can be transferred while the Public Health Inspection of passengers and crew is taking place at Quarantine. The saving in time in expediting the mail is from twenty four to forty hours over the old method of handling on the pier, and, in the case of mail for the Far East, the saving is often from eight to ten days. Chutes and nets are in readiness when the incoming vessels drop anchor When the mail is transferred, word is flashed to the Post Office and trucks are entrained to handle the mail During 1921, 1,552 vessels arrived in Quarantine with mail cargoes, a total of 900,448 bags being received. If laid end to end these bags would extend over 750 miles. On Christmas Eve, 1924, the *Olympic* arrived with 14,151 bags and five mail boats were required to transport it. We are indebted to Mr. W. J. Treloar, who has direct supervision of the Service, for many courtesies to our artist and editor on several trips down the Bay. The Harbor Mail Boat Service comes under the direction of Second Assistant Postmaster General W. Irving Glover, and Mr. R. P. Williams, Superintendent of the Railway Mail Service, New York.

The upper view shows *S.S. Mauretania*, slowing down at Quarantine. She will not have long to wait, for the *President* (middle right) left her pier an hour ago. On the left is shown the chute and protective net. On the lower left is shown part of 4,000 bags of mail. The insert shows an open port, used on some vessels. At the lower right is the ramp taking off the mail at the pier.

Canned Radio Telegraphy

With Phonographic Records the Army Is Learning Modern Methods of Signaling

By Albert G. Ingalls

JOIN the army and learn radio telegraphy! In the World War most of the personnel of the army was required to learn semaphore signaling, a system of transmitting intelligence letter by letter by means of motions of the two arms of the signaler. When, however, these men actually reached France they found that semaphore and wig-wag signals, useful in old-fashioned warfare, were of little use. Electricity works faster, is more accurate and decidedly safer to the signalman than a method which renders him conspicuous.

Telegraphy has now become so important in the army that a large proportion of its members, both officers and enlisted men, must know how to read the language of dots and dashes. How to telegraph by radio or by wire is now being taught to army men in a standardized, uniform manner, by means of permanent wax phonograph records, exactly the kind into which many business men now dictate their correspondence.

Proficiency a Matter of Aptitude

These records do not instruct orally like the phonograph which instructs you in your morning setting-up exercises, but they actually telegraph. When you put one on an ediphone you actually hear a telegraph sounder or a buzzer at work, sending you messages in perfect, clear Morse or continental code. You can even make your own records and then sit back and "play" them, listening to your own style of telegraphy and picking out your own faults. Records of this sort, made originally by an expert telegrapher whose style of transmission surpasses that of the average erring telegrapher in smoothness, ease and clarity as much as legible handwriting surpasses poor handwriting, are now being used throughout the United States Army for instruction in both radio and Morse telegraphy.

In this manner every camp, unit and remote army post, whether in the United States or in the insular possessions, is provided with a mechanical tutor in this important branch of the signaling art. Moreover, beginners are insured against unconsciously acquiring the careless styles of telegraphy of many ordinary instructors. With the new system, which was originated by Captain John P. Ferriter, aided by Captain F. Allen and Master Sergeant E. E. Stradley, all of the U. S. Army Signal Corps, almost anyone, whether a proficient telegrapher or not, may instruct in either Morse or radio code telegraphy.

Recently the writer visited Camp Alfred Vail at Little Silver, New Jersey, not far from New York City, in order to see the new method of instruction in actual use.

The school was in full blast. One large class consisted of officers, mostly captains and lieutenants, seated before long tables, silently absorbing radio signals from headsets and printing the received signals on paper. Several foreign officers were included in this class. The other class, consisting of enlisted men detailed to Camp Alfred Vail from various units of the army, was copying telegraph signals from ordinary Morse sounders. In both cases these signals proceeded mechanically and electrically from a small ediphone whose spinning record made the groups of dots and dashes and spaces which compose the signals.

THE ARMY IS WIDE AWAKE

Learning radio and Morse telegraphy from wax records, at Camp Alfred Vail

Both officers and enlisted men receive identical training, the course lasting nineteen weeks. At the end of this period they are turned out capable of receiving and transmitting telegraphic communications at the rate of twenty words per minute, a good rate of speed for telegraphy. One might logically expect the officers, since they are chosen as officers because of superior intelligence, to learn the art of telegraphy more rapidly than the enlisted men. Yet this is not the case. Neither class excels. Telegraphy is not acquired through the exercise of the intelligence, and the only criterion for predetermining a man's natural *aptitude* for it is an aptitude test, such as the one devised by Captain Ferriter.

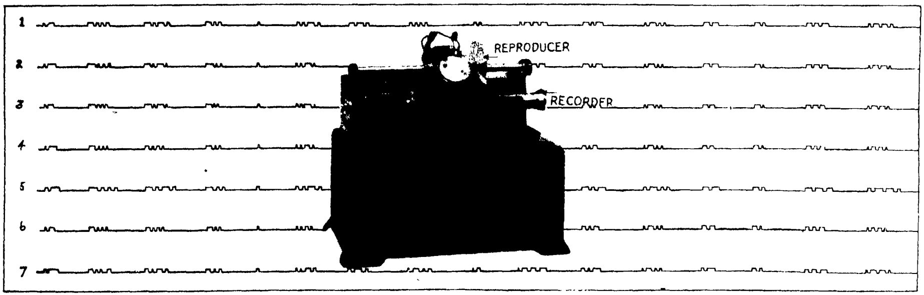
The aptitude test simply consists in making telegraph signals, pronouncing their alphabetical equivalents after each one, and then testing the memory of the men for the retention of these sounds. No effort is made here (or at any subsequent time) to teach the students dots and dashes. Instead, the groups of dots and dashes that constitute letters are memorized as groups.

Individuality in Sending

The mechanical principles on which the records are made are fundamentally quite simple. Alternating current is supplied from a microphone howler at the frequency of 800 cycles per second, a rate which furnishes an agreeable tone for buzzer telegraphy. A telegrapher chosen for his excellent transmitting ability—telegraphers put as much individuality into their sending as there is in ordinary handwriting, and some of it is as careless—sits down and makes and breaks the flow of this alternating current with a telegraph key, making the required signals. This causes a stylus to bite into the groove of the wax record for each alternation while the key is closed. What is produced on the wax record is a series of little indentations, not very dissimilar from those on any phonograph record.

When such a record is placed on the ediphone and run through, this series of indentations makes and breaks the circuit, and through other connected apparatus this actuates the diaphragm of the headset on the student's ears in corresponding manner.

This system of teaching radio telegraphy would be invaluable in time of sudden wartime expansion of the Army, for it would enable millions of men to learn radio telegraphy from instructors who were comparatively unfamiliar with telegraphy. It would be especially useful in the Navy, the National Guard and in the Organized Army Reserve. In short, it replaces a slow, laborious and only partly uniform method of teaching telegraphy with a standardized method capable of rapid expansion in time of war.



ONE WAX RECORD CONTROLS ANY NUMBER OF TELEGRAPH INSTRUMENTS

Few telegraph operators can transmit uniformly perfect telegraph signals by hand, as these comparative records of letters demonstrate

What Are Shooting Stars and Meteorites?

The Vast Majority of These Brilliant Objects Are Smaller than a Pea

By Henry Norris Russell, Ph.D.
Professor of Astronomy at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

ONE cannot watch the sky for an hour on a clear evening without seeing star-like specks of light, which flash across the heavens, and vanish in the twinkling of an eye, leaving perhaps a faint trail of light behind them, which endures for a moment or two longer. Everybody who knows anything about the heavens knows these "shooting stars" are thousands of times nearer than even the moon, and yet are really part of the astronomer's field of study. They are little lumps of matter, which have been pursuing their paths through space for ages, moving through the perfect vacuum of interplanetary space, without disturbance.

Fate at last carries them toward the earth, and no sooner do they enter the outer confines of our atmosphere than they meet with such friction that in an instant they flash into incandescent vapor and vanish.

Once or twice in a lifetime, we may have the good fortune to see a fireball—a great meteor, which lights up the landscape like the moon, or sometimes far more brightly. Such fireballs take several seconds in their flight—as against half a second or so for a shooting-star, and leave a long, luminous train, which sometimes remains visible for many minutes.

Grandest of all—but, alas, not likely to be seen in our generation—is a shower of shooting stars, such as appeared in 1799, 1833, and 1867. In 1833 the sky for hours was alive with meteors, coming far too fast to count. It is estimated that, at the height of the shower, they came at the rate of 200,000 per hour, or more than fifty a second.

Behind these unusual spectacles lie causes very similar to those of the familiar shooting-star. A fireball is simply a larger mass of the same sort of material—sometimes big enough to get clear through to the surface of the earth, and fall as a meteorite, and a meteoric shower results when we meet a swarm of the smaller particles, and they fall not singly, but by thousands.

Meteors Thick as Snowflakes

It is common knowledge, again, that in such cases the swarm is pursuing a definite orbit about the sun, and that, in several cases this coincides with the orbit of a comet. Most of the half-dozen comets thus distinguished are faint, but Halley's comet has its meteors (which appear early in May, coming from the constellation Aquarius). Even though the comet's orbit passes four million miles from the earth's, we get stragglers almost every year. If the orbit came closer, we might have a great display.

These great swarms of meteors, then, are members of our solar system. It seems strange at first that we should not know of their very existence until they plunge into the atmosphere and burn up. Why should not the swarm be visible at a distance, like a faint comet? The answer comes with a realization of the extreme and almost incredible tenuity of even the greatest meteor swarm.

Take the great Leonid shower of 1833, when the meteors appeared "thick as snowflakes" in the sky—perhaps at the rate of fifty, or even a hundred, per second. All that entered the atmosphere within fifty miles of an observer's zenith should have been easily visible to him—that is, all that fell within a circle of 100 miles diameter, and nearly 8,000 square miles area. The velocity with which they approached the latter was a little over thirty miles per second, so that in a single second, more than 200,000 cubic miles of meteor swarm precipitated themselves into the air within full view. This accounted at most for a hundred meteors. Each one, therefore, had about 2,000 cubic miles of space to itself!

These meteors are small affairs, too. We do not know just how big they are, but we can figure out how much energy they send out in the form of light. Assuming that their "luminous efficiency" is comparable to that of artificial light-sources, we reach an estimate of their total energy, and, knowing their velocity, obtain their mass. In this way it can be shown that even a bright shooting-star probably weighs only a few milligrams—less than a pebble a tenth of an inch in diameter.

Brown Brothers

ONE OF THE PEARY METEORITES

Although most meteors are members of our solar system, some of the large meteorites come in as wanderers from the vast depths of interstellar space

One such sand grain or tiny pebble to a thousand cubic miles of empty space would be enough to make a finer star-shower than has ever been recorded. A "cloud" of this sort and ten million miles thick, would be almost absolutely transparent, and utterly invisible, even by reflected light. The most tenuous comet is presumably enormously dense.

But what of the sporadic meteors, which, coming at random from all directions, may be seen on any dark night? On the average, these come in at the rate of eight or ten an hour, which indicates that they must be scattered in space something like forty thousand times more sparsely than in such a swarm as we have just discussed. Each meteor must be some four hundred miles from its nearest neighbors. Do these belong to the solar system, too, or are some, at least, visitors from interstellar space?

There is only one real test to decide this: if they come from outside they must be moving faster in their orbits than if they belong to our system. But to apply this test might seem hopeless, for shooting-stars shoot across the sky so fast that no one can well estimate their speed. But there is "safety in numbers"—that is, in statistical methods of study.

Just after sunset, an observer is on the side of the earth which is at the rear in its orbital motion, while before sunrise, he is at the front. In the former case, only meteors moving the same way as the earth and fast enough to overtake it can enter the atmosphere, but in the latter, all which are moving the other way, or the same way and slowly enough to be overtaken, will be caught. Many more meteors should, therefore, be seen per hour before dawn than after sunset, and this is found to be the case.

If the meteors moved more slowly than the earth, we would get none at all in the evening. The faster they move, on the average, the less will be the difference in the hourly numbers. Hoffmeister, from a careful study made in this way finds that, to account for the observed numbers, the average speed of the meteors must be large—so that most of them must be visitors, entering our system from outside.

In autumn, the earth's north pole is tipped forward—in the direction of the orbital motion—and in spring, backward. More meteors per hour are therefore seen in the fall than in the spring.

For the great meteorites, which get clear through the air without being consumed, and fall to the ground, the distribution is quite the reverse. More fall in the afternoon and evening than in the morning hours, and more in spring than in autumn. Most of these bodies, therefore, overtake the earth, and are moving around the sun in the same direction as the planets.

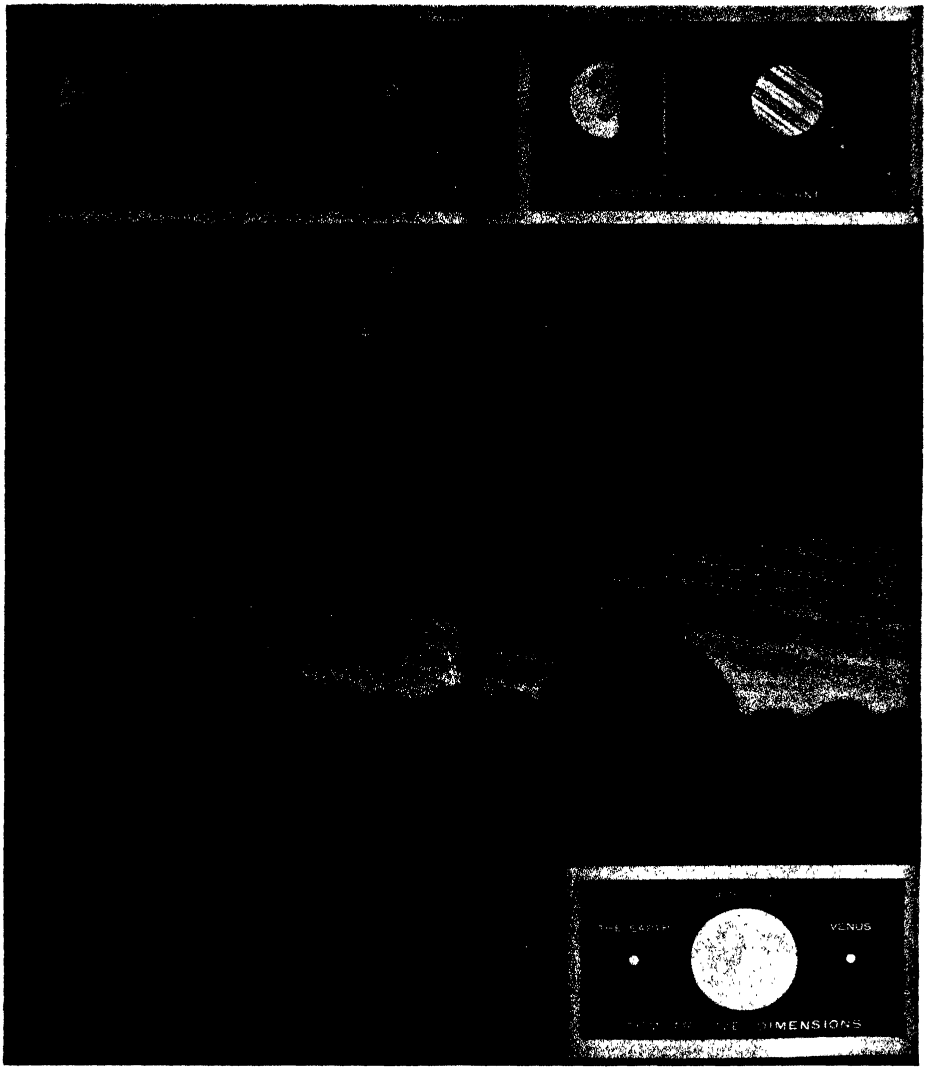
Where Do the Meteors Come From?

Does this mean that these larger bodies are members of our solar system—tiny outliers of the asteroid group? It looks so at first sight, but we must not be too hasty. Bodies which meet the earth will plunge into the atmosphere very swiftly and have an enormous amount of energy to dissipate—so much so that the heat produced may consume them entirely, while slower moving ones may be but partly volatilized, leaving a residual mass to fall to the surface, like a spent projectile.

Such large bodies which may weigh hundreds of pounds have millions of times more energy to turn to heat in the atmosphere than the little shooting-stars. If they turn the same proportion of it into light, the tales told by competent observers, of fireballs which lighted up the whole landscape like day, far outshining the moon, are entirely credible.

When such a body is observed from several stations, its real path may be worked out and, if the time of its flight is also known, its velocity may be found. To estimate the duration of an unexpected and remarkable phenomenon, which lasts at best but a few seconds, is, however, very difficult.

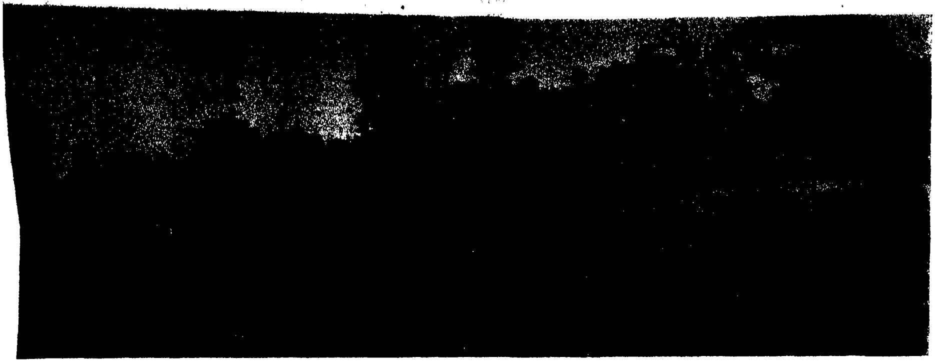
The existing records of this sort usually indicate that meteorites and great fireballs are moving very rapidly when they enter the atmosphere—so fast, indeed, that they must have come in on hyperbolic orbits from interstellar space. It would be difficult, however, to select a type of observation more liable to systematic error, that is, to habitual under- or overstatement, than the duration of such phenomena; and until some more accurate method of determining the time of flight is invented, the results may be taken with some caution. It seems, nevertheless, probable that some at least of the meteorites which have been picked up and placed in our museums are really wanderers from the depths of space. This makes the general similarity of their composition all the more remarkable. Most of them are masses of stone, a few are lumps of iron; but, wherever they come from, they are surprisingly alike in nature.



Courtesy of the "Illustrated London News"

Two Brilliant Planets, Jupiter and Venus, in Conjunction

Everyone was impressed, a short time ago, by the striking spectacle presented in the southwestern skies, when the two most brilliant planets of our solar system were near their conjunction. Here was a sight that for untold thousands of years has periodically excited the awe and stirred the imagination of man. Two heavenly lights draw nearer and nearer together, pass and gradually separate What does it mean? How these interesting events actually occurred, in terms of astronomy, is clearly depicted in the upper corner of the drawing, by the artist, Mr. Scriven Bolton, himself an amateur astronomer



Hillside terraces of scrub and weeds will prevent ruinous washing. This is in the Piedmont region of North Carolina

Shall We Throw Away Our Soil?

The Soil Is Our Most Valuable Asset. Are We Treating It Right?

By Hugh Hammond Bennett
Bureau of Soils, U S Department of Agriculture

THE soil is literally *man's most valuable asset*. From it he must derive the bulk of his food for all time—if we leave out of the calculation possible additions from the laboratory of the synthetic chemist, who thus far has given us little to supplement the products of the soil.

On this continent, we have a fixed area of land, and it is the most variable thing we possess Some millions of acres of this land have value neither for crops nor for trees, and it is of little worth for grazing. Many millions of our acres can be used for growing trees, but not for growing tilled crops The remainder of our soil varies from mediocre to highly productive farm-crop soil

Some of this land is so thin that it will produce almost nothing without heavy applications of fertilizers. Some is highly susceptible to ruinous washing, other areas are adapted to wheat, others are adapted to grass only, or to rice, cotton, tobacco, and so on. Certain types of soil require one kind of fertilizer treatment; other types require other kinds. Probably all types of soil after long usage, will need some kind of soil amendment for maximum production

Importance of Soil Analysis

At present we know neither the extent nor the exact location of these many and varying classes of land. Nevertheless, we should know, because if the character of the soil from place to place is not known, it will be impossible for the agricultural experiment stations to pass on to the farmer, with relative certainty of their correct application, the results of the crop and fertilizer tests carried out upon the definite kinds of soil. Nor will it be possible for a farmer to leave an overcrowded agricultural community and take up land in a new and unfamiliar locality with any degree of certainty as to the productivity or crop adaptation of the soil

Without definite knowledge regarding the extent and distribution of the varying grades of land it obviously will be impossible for economists to determine either precisely or approximately where the nation stands with respect to the farm land situation.

Fortunately the situation is not as bad as the foregoing statements seem to suggest. Actually, thanks to the foresight of the Department of Agriculture for beginning a soil survey of the country some twenty years ago, we do know something about the places of occurrence and the quality of our soils—at least for a very considerable area of them Although less than one-third of the country has been covered by this United States Department of Agriculture soil survey, enough has been done to point to definite lines for attacking the problem of *making better use of the soil*.

An example will explain one of the important results accomplished for a large area· The state of North Carolina, although including none of the rich, lime soil like that covering the great Black Waxy Belt of central Texas, nor any of the "super soil," such as that spread over the Mississippi River bottoms, produces, nevertheless, more cotton per acre than any other of the important cotton states. Not only that, but in recent years it has come up to fourth place among all the states of the Union in the value of its crops. Yet one-third of its area is exceedingly mountainous, other large tracts consist of undrained coastal swamps, and there is not within its limits a single acre of the black prairie soil that enticed swarms of home-seekers to cross the Alleghenies to the Missouri and Mississippi valleys.

SUBSOIL HEALTH IS ESSENTIAL

The productivity of a soil often depends upon the character of the subsoil Therefore, soil surveyors bore into and take samples of the subsoil down to three feet deep

How did this large production per acre happen? What were the underlying causes that brought about this marked agricultural advancement? For one thing (there were a number of causes), the "Tar Heel State" began more than twenty years ago to study, to classify, and to map its soils. As soon as the important types of soil were recognized, and when their place of occurrence was determined, sub-experiment stations and outlying test plots were established upon these delimited soil type areas. Moreover, the old-fashioned method of sending out state-wide bulletins of advice, based on fertilizer experiments carried out upon a *single* type of soil at the old central station, was abandoned.

North Carolina Farmers Progressive

Instead, from the work done on the different North Carolina soils, the farm advisors gleaned information which was definite. It was applicable to farms situated on land *like* that where the tests were made. It was found, for example, that the red clay of the Piedmont granite lands needed little or no potash either for cotton or corn, and therefore farmers were advised not to use this fertilizer for these crops on land of this nature because the granite rocks from which these red lands have been formed are already rich in potassium, and the soils derived from the disintegration of that kind of rock are usually amply supplied with this form of plant food. In the sandy, coast country, on the other hand, where the soils were found to be wholly different, it was learned that potash was needed in liberal amounts.

The North Carolina farmers were told what to do for each kind of soil. They did it and the results expressed in money value for the crops grown is

A TYPICAL CASE OF EROSION

Trees growing in the bottom of gullies arrest washing and start soil regeneration by causing the gullies to fill

told effectively by the Government statistics referred to in a preceding paragraph.

With an abundance of fertile land in young America there was not so great a necessity for the adjustment of crops to the soil But with a change from an expansive to an intensive type of agriculture --which change a diminishing land supply must inevitably bring about—the need for closer observance of the principle of fitting crops and fertilizers to soil variation will be more and more imperative.

In various parts of the United States, corn is being grown on land, which, while very suitable for other crops, is but poorly adapted to corn. Vast areas of semi-arid and arid grazing land have been planted to crops where there is rarely enough rainfall to insure more than a pittance of yield. Many farmers are living wearisome lives trying to derive meager sustenance from stubborn clays and droughty sands, where only trees can really succeed Unscrupulous and ignorant land agents are selling low-grade and worthless land to credulous farm-builders as "the richest soil on earth"; the writer recently saw stunted grape fruit and cotton on land sold at $300 an acre to a hopeful farmer, new to the locality, where the soil was so charged with toxic alkali salts that an average yield per acre of one crate of fruit or twenty pounds of cotton could not be hoped for

Thousands annually buy farm sites solely upon the representations of land agents, often without seeing the land. Others misjudge the crop capabilities of land after they have seen it, usually because it is impossible for the average man to be a soil expert, or because his judgment succumbs to the convincing enthusiasm of the selling agent. These mistakes are often made in localities which have already been covered by soil surveys Many people do not know that both the Government and most of the states are constantly publishing new soil maps and soil reports, which not only describe the various soils in detail, but which show on carefully made maps the precise location of the different classes of land. These maps and reports have been issued for numerous representative areas throughout the agricultural regions of the country. They can be had without cost from the State Experiment stations, or from the United States Department of Agriculture. They can also be seen in most public libraries

Soil problems, whether they concern the home vegetable garden or the large farm, can best be diagnosed by the soil technicians of the experiment stations and departments of agriculture when the type of land has been identified.

Erosion Destroys Ten Million Acres

A chemical analysis alone can not be depended on to determine what a soil may need. Many other facts must be known, such as the character of underdrainage and aeration, subsoil condition with respect to hardpan or gravel beds, and texture of both the soil and subsoil. If, in the absence of regional soil maps, the type name of a particular kind of soil cannot be determined, it is sometimes possible to have this done by sending samples of the soil and subsoil to competent authorities.

Soils not only vary in productiveness, adaptability and needs, but in their power to withstand erosion Once a gully is permitted to get beyond control, some types of soil, such as the red, sandy loams of the Atlantic and Gulf Coastal plain and the wind-deposited silts bordering the bottoms of the Mississippi and Missouri Rivers (the loessial regions), melt away almost like sugar in water The problem of saving the soil from destructive erosion over millions of acres of sloping land throughout the humid portion of the United States is one of the most difficult tasks confronting agriculture In a single county in the southern Piedmont section of the Atlantic Coast states an area of 90,000 acres formerly rated as good farm land was classed by a recent survey as *rough, gullied land* unfit for anything but scant grazing and timber. Most of this land can be reclaimed to agriculture only through

A REGIONAL SOIL MAP

Detailed maps are available for the asking The vari[illegible] kinds and grades of soil are shown in different colors

centuries of cumulative rock decay and the other natural equally lengthy processes of soil building

Probably not less than eight or ten million acres of land, once of medium to good value for agriculture, have been permanently destroyed or made temporarily unfit for cultivation by soil wash Areas many times as great as this have been seriously impaired by the same process Erosion or soil wash is impoverishing our sloping farm lands at a very much faster rate than are the crops which are being taken from them Recently the Missouri Agricultural Experiment Station showed by actual measurement that within 21 years, erosion has removed seven inches of the surface soil from an important type of Missouri farm land, which is plowed regularly to a depth of four inches In bluegrass sod, however, the same type of soil erodes at the rate of only seven inches in 3,547 years.

Surely something more than is now being done, should be done to check this enormous wastage It is a national duty—if not the personal duty of every citizen who can think beyond the absolute needs of the moment—to take some active part in opposition to unrestrained soil erosion If one is unable to start a woodlot, let him establish a plot of permanent sod, or build hillside terraces in some field which, in its present condition, is too steep for the growing of clean-tilled crops

NOT USED TO THE BEST ADVANTAGE

Here we see unprofitable cotton growing on deep, loose sand which is much better suited to the raising of peaches, berries and early vegetables

THE USE OF FERTILIZER IS OFTEN IMPERATIVE

As is clearly demonstrated in this photograph No fertilizer was used on the rows at the left, but the rows on the right were completely fertilized

The Standing Stone Forests of Wyoming

By Guy E. Mitchell

United States Geological Survey

THERE is a log of the *Sequoia gigantea*, commonly known as the Big Tree, that has been lying on the ground in one of the National Parks of California for nearly 400 years the wood of which as yet shows no signs of decay. But there are trunks of Sequoias standing in the Yellowstone National Park whose measure of age is in the hundreds of thousands, indeed millions of years. They too are perfectly preserved, moreover they will endure for another millennium. Nothing in the wonderland of the Yellowstone is more wonderful than its standing stone forests, older than the surrounding rocks themselves and of harder texture.

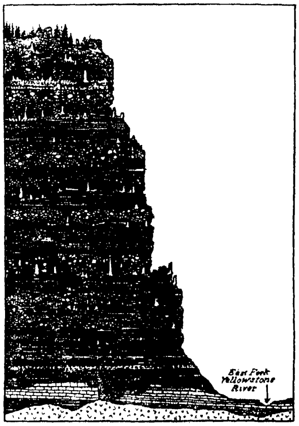
During the ages the Yellowstone River has cut a great trench 2,000 feet deep, down from the top of the plateau to the present bed of the river On this high plateau stand the trunks of a petrified forest embedded in rock which was once soil.

There Were No Men

At the bottom of the gorge where the river flows you may see the standing stumps of another petrified forest immeasurably older than the stone forests 2,000 feet above, while in the space between, jutting out from the canyon walls, and on the steep slopes are the stone stumps of thirteen other stone forests—fifteen in all, one above the other, the most remarkable evidence of fossilization in the world

The story is one of the dense vegetation of an early world, of terrific volcanic eruptions submerging the forests and of chemical metamorphism on a gigantic scale—natural phenomena of millions of years ago

In the very long ago, before the birth of the Yellowstone Plateau, before the Yellowstone River, giant forests of conifers flourished upon a low, flat country, only a little above sea level, bordered by the peaks of great volcanoes; a magnificent forest it was through which roamed the gigantic beasts of the early world. There were no men. Then one day came a vast eruption The volcanoes threw forth countless tons of material, and this first forest, the lowest one of the fifteen as you view them from the bed of the Yellowstone Canyon, was completely buried under the masses of falling ashes and pumice. Then rains followed and Nature's chemistry began its slow and perfect work, the silica-charged waters "pickled" and preserved and gradually changed to stone the entire forest.



FOSSIL FORESTS OF YELLOWSTONE PARK

Section through 2,000 feet of Specimen Ridge, showing a succession of fifteen buried forests The broad valley was carved out after the forest beds were deposited

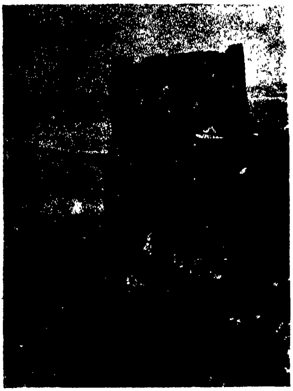
After this first forest was buried quiet was restored in the land and the volcanic material on top of the forest was reduced to soil and a second forest sprang up. The geologic evidence points to the possibility that the roots of this living forest may have actually entwined among the topmost fossil branches of the first forest.

Forests on Top of Forests

After many centuries the volcanoes roared forth again, and the second forest, the stumps of which you may see a short distance up the slope of the canyon wall, was likewise buried and petrified as had been the first one. Then grew up another forest and again came a deluge of ash and scoria submerging it Such tremendous processes were repeated again and again during a vast period of time until 2,000 feet of volcanic material had been showered over the land by the volcanoes and the great Yellowstone Plateau built up to its present height while no less than fifteen forests had grown and been entombed, one above the other.

Finally the volcanoes ceased their activity, forever we hope, man came into the possession of the earth, and the growing forest of today appeared. But even before this, the disintegrating action of rain and frost set in, uncovering the topmost stone forest and cutting the great Yellowstone gorge through its plateau, in the heart of which today you may read the story of its origin and see the trunks and stumps of its many forests as they have been converted into the hardest of agate.

Many of these trees, standing on the slopes and steeper hillsides rise to a height of 20 to 30 feet, and are covered with lichens and discolored by frost and rain. Millions of years old and of solid stone, as the traveler observes them standing upright among the stumps and trunks of the living forest he will



A ROCKY LOOK-OUT

A giant petrified stump nine feet in diameter In the background is the Yellowstone River 2,000 feet below

have to take a second and closer look to convince himself that they are really fossil trunks

Some conception of the magnitude of the volcanism which submerged these forests may be gained from a comparison of the results with those of historic volcanic eruptions The Vesuvian submergence of Pompeii and Herculaneum, for instance, under a mass of volcanic ejecta which has recently been dug through, was a matter of a few feet, yet here in the Yellowstone we see 2,000 feet of solid rock all consolidated from volcanic ash and pumice

Many visitors to the Yellowstone pass by the petrified forests without notice, for they are less spectacular than the giant geysers and other wonders of the Park though really far more remarkable But, as you ride up the trail that meanders along the smooth river bottom, if you are on the lookout you will note that the cliffs on the right-hand side are covered with a multitude of these bleached stone trunks looking for all the world like stumps of ordinary decaying wood, and in the precipitate middle portion of the mountain face you will see rows of pillared trunks standing out on the ledges that resemble the columns of a ruined temple. On the lesser slopes, farther down, but where it is still too steep to support vegetation, save a few pines, the petrified trunks fairly cover the surface. Many years ago these appeared to Professor Holmes of the Smithsonian Institution, the discoverer of the Yellowstone petrified forests, to be the remains of a recent forest.

The largest petrified trunk in the Yellowstone is a little over ten feet in diameter, which includes a portion of well-preserved bark while at the summit of Specimen Ridge stands a trunk twelve feet high that is twenty-six and one-half feet in circumference, without the bark. This giant tree, literally older than the hills, is a true *Sequoia* and is so closely allied to the modern redwood of California as to be, even to the botanist, hardly distinguishable from it It would be interesting to know the height to which this tree attained ultimately, but it is believed by geologists, from what is known of its living representatives, that it may have been well over two hundred feet

NOT FUEL FOR THE CAMPER

One of the many petrified trees in Yellowstone Park The iron fence protects it from souvenir gathering tourists

Alaska Once Had Tropical Climate

In other parts of the petrified forests there are trunks fifteen and twenty feet high and in some cases the bark and knot holes are perfectly preserved Some of the trunks are hollow in the center, the cavities lined with brilliant amethyst crystals.

Petrified woods are interesting objects for microscopic study even by the layman, who may have a microscope with a capacity of thirty or forty diameters. When thin sections of the "wood" are carefully ground to a thickness of one three-hundredths of an inch and placed under the microscope they show the original structure of the wood perfectly, all the cells being distinct By studying these thin sections Dr F H. Knowlton of the United States Geological Survey has identified a great variety of species of the ancient world in the various fossil forests of the Yellowstone.

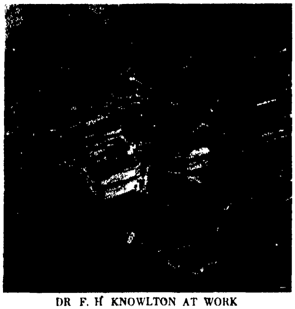
Besides the redwood and many other kinds of conifers Dr Knowlton has discovered species ranging from the vegetation of a tropical clime to that of the north temperate, indicating great changes in climate since the first forest of the Yellowstone was buried in volcanic ash Among the species he has identified of these ancient natives of Wyoming are oak, sycamore, buckthorn, breadfruit, magnolias, bay trees, walnut trees, birch, persimmon, dogwood, ash, hickories, elms, cinnamon, figs and many other species which do not grow in Wyoming at the present time and some of which are found nowhere in the United States

Petrified or fossil wood itself is no rarity Stumps and logs of it are found in all quarters of the globe, from far northern points of arctic exploration to frozen points in the Antarctic Even giant fossil palms have been found in Alaska, incredible as it may seem that that land of snow and ice should once have been almost tropical But wherever found the trunks are prostrated and lie broken and scattered

In the wonderful collection of petrified logs in Arizona the name "forest" is not strictly appropriate for the petrified trunks are all prostrate and evidently did not grow where they now lie. They apparently drifted down some ancient watercourse and lodged in a huge eddy or sand bank and later were buried under deposits of sand and clay But the petrified forests of the Yellowstone stand where they grew

UPRIGHT TRUNKS ON SPECIMEN RIDGE

This view is particularly interesting because it shows the spreading roots of the petrified trees

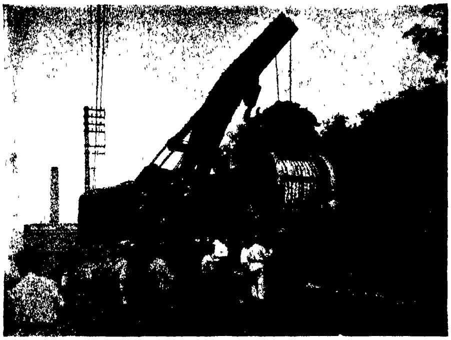


DR F. H KNOWLTON AT WORK

*He is examining an excellent specimen of the ancient red wood—*Sequoia magnifica, *he has named it*

THE DEAD BESIDE THE LIVING

Trunk of an ancient pine some 500 times older than historic civilization standing alongside growing pines



THE WRECKING CRANE COMES INTO PLAY

Loading a reel of submarine cable onto a flat car by means of a wrecking crane This reel weighed 17 tons and had to be placed directly over the trucks at the end of the car

CABLES GOING OVERBOARD FROM A BARGE

Note the swiftness of the current The cables are clamped to a wire rope which is attached to an anchor to keep them from creeping downstream Two cables were laid at a time

An Epoch-Making Engineering Achievement

The Laying of High-voltage Submarine Power Cables Across the Mississippi

By Francis A. Westbrook

NOT long ago a new type of submarine telegraph cable was laid across the Atlantic Ocean which marked a very great advance in the art of submarine telegraphy. At about the same time a group of submarine power cables to operate at 33,000 volts was laid across the Mississippi River at St. Louis, which also indicated an important advance in the art of power transmission. While the transmission of power, even in such large "blocks" as in this case, certainly seems a prosaic and impersonal affair when compared to the transmission of messages between people, it is nevertheless just as vital a matter to the welfare of mankind as is international communication.

Although little attention has been paid to this installation, it has been an epoch-making undertaking from the engineering standpoint, not only on account of the high voltage, which is the highest so far used in this country for submarine cables, but also because of the fact that it was necessary to splice together two sections of cable in mid-stream This is the story of the solution of one of those problems which electrical engineers find it necessary to face with increasing frequency on account of the very rapidly expanding use of electrical power in all branches of human activity.

Cables of Unusual Size

The principal characteristics of submarine cables for power transmission on a large scale are that they are comparatively short--in this case half a mile, that they usually have three large conductors, that they operate at high voltage, and that on account of the number of conductors, thick insulation, lead sheathing and large armor wire, they are heavy, stiff and cumbersome to handle Paper saturated with petrolatum, or vaseline, is the only practicable insulating material for such high voltages and the only possible way to make this waterproof is by surrounding it with a lead sheath which adds greatly to the weight stiffness and diameter An idea of the size and make up of these unusual cables may be gained from the following

There are three conductors of 350,000 circular miles each.

The conductors are sector shaped instead of round, so as to decrease the diameter of the cable after the three are "cabled" together

The paper insulation around each conductor is 23/64 inch thick and in addition, insulation to a thickness of 9/64 inch is wrapped around the three assembled conductors.

The lead sheath is 9/64 inch thick

There are 42 galvanized steel armor wires about ¼ inch in diameter.

The diameter of the finished cable is 4.4 inches

JOINTS GOING OVERBOARD

When they are raised up, the cable barge is moved out from under them, the cables unwinding from the reels as it proceeds The joints are then gradually lowered into the river, thus avoiding sharp bends

The weight of the finished cable is about 25 pounds per foot

It is evident that cables like these cannot be installed across a river by a large steamer with all the necessary apparatus on board, but that smaller, easily maneuvered vessels must be used and the equipment for doing the work assembled especially for the purpose.

Although underground cables are being made for constantly increasing voltages, this rate of increase has been slower with submarines on account of the greater difficulty of making and installing them. The manufacturer who made these cables had never done anything just like it before, so it was necessary for his engineers to do the best they could with the means at their disposal. Thus we see in one picture that very heavy reels of cable, weighing 17 tons apiece, are being loaded on flat cars for shipment to St Louis by means of the railroad company's wrecking crane. This was a very simple means to employ and, until the demand for such cables becomes much more frequent than is likely for some time, it is much more economical than setting up specially purchased apparatus in the factory, which would only be used occasionally. The fact that only two of these reels could be placed safely on a single freight car will give an idea not only of their weight but also of the care which must be exercised in handling them.

Great Danger from Moisture

This great care in handling may seem rather unnecessary in view of the heavy armor and the generally heavy character of the cable; but, in common with many other carefully constructed objects, it is vulnerable in certain respects and cannot stand abuse. The great danger lies in the possibility of there being a hole in the lead sheathing which might permit the entrance of moisture and cause immediate breakdown of the insulation under the pressure of the 33,000 volts. A sharp bend is particularly liable to cause a crack in the lead which, in part, accounts for the large diameter of the reels on which the cables are shipped. The elaborate precautions taken later, during the laying of the cable, to prevent unduly sharp bends and mechanical injury to the lead are all to this end.

The reels of cable were sent to the Cahokia Power Station at East St. Louis, on the east side of the river, where they were unloaded from the freight cars by means of a traveling crane used for construction work on the power house and placed directly on barges. One of our illustrations shows the steel barge with reels set up so that they can turn on iron bars passed through the center for axles. One end of the cable is made fast at the power house and the barge containing the reels is then moved out into the river, the reels unwinding the cable as the barge progresses.

Cables Have to Be Anchored

It was necessary to lay the cable as closely along a predetermined route across the river as possible but, on account of the swiftness of the current and the slow speed at which the barge had to travel, this was no easy task. The most practicable way to accomplish this was to have several anchors in the river with ropes to the barge. By pulling on these ropes, which extended at various angles, by means of a donkey engine on the barge it was possible to pull the latter accurately in the desired direction. From time to time, as progress was made, some of the anchors had to be changed. This was done by a tugboat.

Another precaution, which had to be taken, peculiar to a river crossing of this kind, was to anchor the cables themselves so as to counteract their tendency to creep down stream, due to the force of the current. Stressing the cable beyond a limited amount would be dangerous to the insulation on account of the high voltage. Thus, in order to make doubly sure that no undue tension could be brought to bear by the current, the cable was laid in an arc bent against the direction of flow. Any tendency, therefore, to move with the current would produce slackness rather than tension.

We now come to the most delicate part of the whole operation—that of making the joints in the cable. Whereas it is a well established practice to make the single-conductor telegraph submarine cables of almost any length, a thousand miles or more, this is impossible with the three-conductor, lead sheathed power cables. It is a question of manufacturing limitations, which it is not our purpose to discuss in this article.

PUTTING THE ARMOR IN PLACE

In matching up the ends for the joint, the cable was cut back under the armor wires, which were not cut. When the joint was completed, these armor wires were laid over the joint from each end and bound in place as shown

The fact remains that two sections of cable had to be joined together in the middle of the river and in such a way that the 33,000-volt current could not break through. It is a very different matter from that of making joints in the single conductor, gutta percha, insulated, non leaded telegraph submarines where the outside pressure of the water at great depths tends to compress the slightly plastic insulation. Great care must be taken to avoid pin holes or any other imperfections which might permit the entrance of moisture. With these power cables there is the extra high voltage continually tending to break out from within, not only by virtue of its direct force but also by a gradual weakening process known as "ionization," whereby if air be present, the resisting property of the insulation may be slowly destroyed until a point is reached where the cable fails, perhaps with great violence because of the enormous capacity of the power house furnishing energy to it.

To make one of these "high-tension joints," as they are called, requires very careful workmanship, quite on a par with any of the skilled crafts. First, the armor and lead sheathing must be removed from the ends of the cables to be joined; next, the insulation from around the copper conductors must be removed so that they may be firmly connected together; after which the exposed copper must be covered again by winding tape around it by hand. This must be done carefully and evenly so as not to leave any "air pockets" or particles of dirt or metallic substances which would tend to weaken its insulating quality, for it must be remembered that 33,000 volts represents a powerful disrupting force which can only be confined within prescribed limits by closely obeying certain laws of nature, and the greater the force, or voltage, the less the margin of permissible deviation from these laws. For example, a certain piece of cable (not of this group) under high-voltage test in the factory was observed to develop a "hot spot." That is, during a short period, say five minutes, while the conductors had a high voltage impressed upon them the cable as a whole showed no abnormal reaction except for one isolated spot which began to heat up. If this had been allowed to continue the insulation would have become charred or "carbonized" and, carbon being a fairly good conductor, the cable would have broken down. As it was, the current was turned off and the insulation carefully stripped for examination, which disclosed the fact that the paper insulating tape had become wrinkled in some unaccountable way, with an air pocket as a result. This is exactly what has to be guarded against in making the joints, only it is more difficult when the work has to be done by hand in the open than in the factory and by machinery.

Hot Oil Boils Out Air

When the conductors are joined together, a lead sleeve of larger diameter than the original cable is slipped over the exposed insulation and soldered to the lead sheathing at each end. It is then filled with hot oil, which boils out all air and moisture from the texture of the insulation and fills up all vacant spaces. The hole through which the oil is poured is then sealed and the joint is completed electrically.

Mechanically it is not complete. The armor wires have to be put back in place and laid up around the lead sleeve covering the joint, and various precautions must be taken to stiffen the cable at this point to prevent the occurrence of sharp bends which might result in cracking the lead sheath.

The operation of making a joint as described takes a full day, during which time the cable barge must be anchored firmly to prevent its being worked downstream in the swift current.

33,000-VOLT CABLE JOINTS READY TO GO OVERBOARD

The joint is strengthened mechanically with strap irons and sharp bends are guarded against by fastening the whole to a very heavy plank, by means of which it may be lifted into the water by a derrick without injury. This picture gives a good view of the donkey-engine whose principal function is to maneuver the barge by pulling on the anchor lines

MAKING THE JOINT BETWEEN THE TWO REELS OF CABLE

This operation is necessary for making the complete crossing. After the copper conductors are soldered together with the help of a copper sleeve, insulation is put on again by winding on tape by hand. A lead sleeve is then slipped over the joined conductors and soldered ("wiped") to the lead sheathing of the cable. This is filled with hot oil and sealed

THE last frontier of unknown Alaska has been penetrated with the exploration of some 7,000 square miles in the extreme northern reaches of the territory, the greater part of which had never been seen by a white man. This has just been accomplished by a Geological Survey expedition sent out last February to continue the exploration of Naval Petroleum Reserve Number 4 in Arctic Alaska. Gerald FitzGerald and Walter R. Smith, the topographic engineer and the geologist of the party, have returned after some seven months of work, during five months of which they did not see any human being except the other two members of their party and were entirely out of communication with the rest of the world. The other members of the party were Faye Delezeno and Walter R Blankenship

The official report of the trip is a simple narrative of the doing of the job, which was part of the routine duty of these men and to which they had been assigned because of their seasoned ability. But, through this apparently commonplace account, there runs an enthralling undercurrent of the adventure and romance that are inseparable from exploration in unknown and dangerous regions.

ARCTIC STYLES

Artistry in dress is not confined to civilization

Everyday Heroism

The field of heroism is not confined to the battlefield or the broad expanses of the sea. It is to be found in many a sphere which the public mind little associates with those feats of courage, which win the greatly prized title of heroic. At the first thought, one would not associate heroic service with the United States Geological Survey. To most people, mention of that service suggests thoughts of a transit, a level, a notebook, healthy outdoor life by day and a comfortable tent by night. The accompanying story of geological survey work in the remote silences of northern Alaska will prove to you, gentle reader, that the members of this service may be called upon, in the performance of their duty, to face hardships and perils which we are accustomed to associate more with the search for the North Pole than with the day by day routine of engineering field work.

The expedition sailed from Seattle on February 28 and arrived at Nenana, the last outpost of the Alaska Railroad on March 10. On March 12 the party set out with two dog sleds, each loaded with 400 pounds of instruments and camp equipment, for the head of the Colville River, more than 1,000 miles away The wilderness route led down the Tanana and Yukon rivers, overland to an Eskimo village on Bering Sea, northward along the coast, across Norton Sound and Seward Peninsula, and beyond the Arctic Circle to Kotzebue, where the party arrived on April 8 The distance of about 700 miles was done in twenty-six days of actual travel.

Over almost the entire distance one man ran behind each sled to guide it by handle bars For these men there was no riding, wrapped in warm blankets or parkas, as you may perhaps picture Alaskan travel. Often it was necessary to go ahead of the dogs on snowshoes and break the trail which was obscured by heavy snows. The snow was four or five feet deep and where any one of the sledges missed the old, beaten trail by a few inches, it upset in the soft, deep snow. This usually resulted in a dog fight.

The arrival at Kotzebue ended the first stage of the journey, the greater part of it on the trail over which the diphtheria antitoxin had been raced to Nome a few months earlier. But with the Geological Survey party there was no race against death—to save the lives of men and women—nor other spectacular feature in which human interest figured prominently. What these men did, Geological Survey men have done in Alaska every season for years—their day's

WHERE AM I?

Taking a "shot" with the sextant, just as at sea

FITZGERALD AND HIS "HUSKY"
Arctic dogs are like humans in their characteristics

work each day—and so, although every day actually thrilled with danger and adventure, these toughened scientist-explorers will hardly admit that anything that they encountered even approached an adventure

When the party left Nenana the weather was warm and it had been raining. Before they left the Yukon it was thirty degrees below zero and a heavy snowstorm was encountered while they were crossing Norton Sound on April 1. The snow crusted on the eyes of the dogs and it was necessary for a man to go ahead of the team. At times it was impossible to see the lead dog from the sledges. When the party reached Koyuk, the Eskimo roadhouse keeper asked in amazement: "Where you come from? Didn't think anyone could travel through this storm."

Kotzebue marked the last roadhouse on the trip. Thereafter the party camped in tents, except one night at the native village of Noatak, which contains a population of 250, with neither a white man nor a half-breed, and not one of whom uses tobacco. The Eskimo drivers would not go farther than the head of the Utukok River, on the arctic slope, for fear that the snow would melt before they could return. As they turned back the little party of four white men was alone in the arctic snow-clad waste

Topographic and geologic mapping was begun from earlier surveys on the south side of the Brooks Range and carried across to the headwaters of the Utukok River. As fast as the weather permitted, the supplies and a boat were relayed on toward the head of the Colville River. This river was partially explored the year previous, and a canoe which had been cached was picked up and brought overland to the Colville. Several times the river opened and froze again during heavy storms, but on May 30 the actual exploration of the upper Colville was begun.

Over white rapids and angry whirlpools and beneath undercut snowbanks the men paddled on, never knowing what would happen around the next bend, but realizing full well that if a boat should upset its contents could not be regained or replaced, and that if anyone were injured there were neither hospital nor physician within reach Often the boats struck rocky bars and had to be lifted across The dogs followed along the banks, but in trying to keep within sight of the boats they swam across the river many times each day. The party followed the river for more than a hundred miles and mapped an area from twenty to thirty miles wide on each side

CARIBOU MEAT!
A most welcome feast after canned rations

In making the trips over the rough tundra away from the river, the dogs were used as pack animals, carrying packs of from twenty-five to thirty pounds for distances of eighteen to twenty-eight miles a day Over the shorter portages some of the dogs carried burdens of forty pounds Snowstorms were frequent but the snow did not remain on the tundra. By the middle of June the hills were dotted with flowers

Formerly the Eskimos lived along the banks of the Colville. Their old igloos, pieces of clay pottery, and broken bone implements were found At one point in this northern country a giant leg bone of a mammoth was found The Eskimos are stated to have migrated to the coast many years ago in order to be nearer the traders. Parts of the interior northland are, as a matter of fact, unknown to the Eskimos

A CREVASSE IN A GLACIER
One of the many dangers which the surveyor faces

By July 13 the mapping work was tied in to a previous survey of the central part of the Colville Valley, and the party turned south to the Etivluk River, a large tributary of the Colville This river was ascended about 80 miles to its source, at the summit of a pass in the heart of the Brooks Range.*

The Etivluk is a swift, turbulent river, flowing over many rapids and bars The dogs again proved very useful in lining the boats; but many times a day for fifteen days all the men waded in swift ice water above the waist, to get the boats across the rapids.

A low pass was found at the head of the Etivluk and a portage of less than one mile put the explorers on the head waters of the Aniuk River, tributary of the Noatak River. The party descended the Aniuk about fifty miles and closed the new surveys by connecting in to the earlier surveys of the Noatak. The return trip was made down the Noatak to Kotzebue, thence to Nome and Seattle, where the party arrived on September 16

ROUGH GOING
In the arctic, the endurance of both men and dogs is tested to the utmost

AN OVERNIGHT CAMP
The dogs are tied out in the open They prefer it to being under cover

---

*Formerly the Arctic Range but renamed "Brooks Range" after the late Dr. A H Brooks of the U S Geological Survey

Electrical Research Applied to the Phonograph

A New Method of Reproduction Brings a Sense of Realism to Phonographic Presentation

By Joseph P. Maxfield
Bell Telephone Laboratories, Inc

A SUCCESSFUL solution of the problem of phonograph reproduction requires an alliance between science and art. Most entertainment of a musical nature has involved heretofore at least two senses—hearing and sight, while phonograph reproduction and, for that matter, any mechanical form of musical production involves hearing only. It is insufficient to reproduce faithfully the audible part only of an artistically successful musical performance and it is necessary in some way to simulate the so-called "atmosphere" or contact between the artist and the audience.

HENRY C HARRISON
He exhibits an opened up model of the new phonograph, of many of whose principles he is the inventor

There are several factors which tend to produce the sense of reality and the illusion of the presence of the artist The most important of these is control of the acoustics of the room or hall in which the record is made. It has been shown by Sabine that studios used for piano music should have a time of reverberation measured by his method of 1 08 seconds. Our experience has indicated that this figure is very closely correct for other types of music This figure of Sabine's assumes two ear listening, that is, binaural listening With a "one ear" system such as radio transmission or phonographic reproduction, the ability of the listener to separate the reverberation from the direct music by means of the sense of direction is completely removed and the listener has thrust upon his attention an apparently excessive amount of room echo. Experience has shown that a time of reverberation ranging from slightly more than one half to slightly less than three fourths of the Sabine figure simulates in the reproduced music the effect of a room with proper acoustics When this effect is properly produced, the person listening to the reproduced music is conscious of the fact that the music is being played in a continuation of the room in which he is listening and a sense of spacial depth, nearness to the artist, is created

Another important factor is the ability to reproduce the weaker sounds made during the act of performing music. Since many of these sounds, such as the sibilants in speech, the intake of breath of the singer, and the touch of the bow of a stringed instrument are carried mainly by the higher frequencies, this portion of the musical range becomes important in this connection and is very important to the proper rendering of the tone quality of the various instruments When these higher harmonics are not present in the reproduced music, the impression is created that the performance is being carried on behind some sort of heavy curtain or screen and the characteristic tones of such instruments as the violin, oboe and brasses are considerably distorted

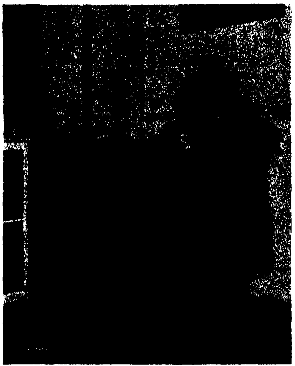
Similarly, very few musical selections can be rendered in such a manner as to produce the effect of the artists being in the room with the listener—that is, the necessary sense of intimacy—unless they possess power or body in the heavy low toned notes. This requires that the reproduction shall include the low notes of the musical scale.

Intensely Sensitive Reproducer

In this connection, the fact should be made very clear that a reproducing system which fails to reproduce all frequencies below, let us say, 300 cycles per second, will, nevertheless, reproduce the auditory sensation of a musical note whose fundamental is below 300 cycles even though the fundamental and one or two of its harmonics have been eliminated in the reproduction While this elimination of the lower frequencies in no way changes the pitch of the note, it does change what is commonly called the "character" or "timbre" of the tone The change in the quality is such that the note seems to lose the heavy body in the low frequencies and becomes a rather thin metallic type of note The quality of tone characteristic of the older type of talking machine was largely brought about by the failure to reproduce these lower tones.

This leads naturally to the most important part of the scientific work which it was necessary to complete in order to solve even approximately the problem of satisfactory phonograph reproduction. In its broadest sense, this part of the problem may be stated as that of taking sound from the air, storing it in some permanent way and releasing it again without appreciable change. It is immaterial from a general standpoint whether the means used are mechanical, electrical or a combination of the two. The choice of which method to use will depend largely upon the commercial factors surrounding the specific purpose for which the reproduction is being made. For instance, it is quite probable that the means chosen for reproduction in the home could differ materially from those used in a large hotel ballroom or in connection with synchronized motion pictures

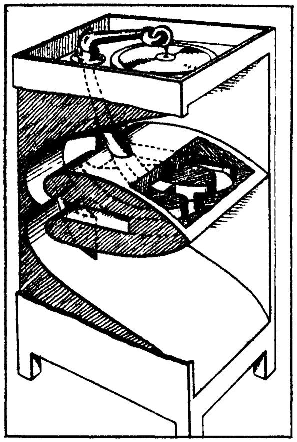
THE AUTHOR
Joseph P. Maxfield is examining a reduced-scale model of the new type horn


Courtesy of Victor Talking Machine Co
LUCREZIA BORI
Hears her voice on the new phonograph It is a more perfect reproduction than artists have secured in the past

Where the machine is to be used for reproduction in the home, it has been found that the energy which can be taken from the record is more than sufficient to give a volume even exceeding that required for a large living room. It therefore appeared unwise to introduce an unnecessary electrical link between the mechanical system which is operated by the record and that which must be used to radiate sound into the air.

The history of the development of nearly all of the technical arts has shown that from time to time the progress of the art has received an impetus through the adoption of some new principle. In the periods between these advances take place the improvements in details which result in the new principle being applied to the best commercial advantage.

This has been so in the talking machine art. Early in its development, the introduction of a duplicating process by means of which large numbers of records on long wearing material could be made from a first impression on soft wax, allowed the talking machine field to be exploited commercially. Then the development of a smooth running spring-driven machine in place of the early hand-operated ones opened up a field of higher class music.



PHANTOM CROSS SECTION

Of the acoustic passages, showing their convolutions and gradual enlargement in two planes

The method of reproduction which will be described represents the outcome of the application of new principles to the talking machine art. These new principles have been largely borrowed from the results of research on telephone circuits. Mechanical analogies for electric circuits have been used in the teaching of electricity for some years. Moreover, in the field of application, particularly in the art of communication problems of wave transmission in electric circuits have been very completely worked out by Campbell, Zobel and others.

When a survey of the talking machine problem was made, it was early realized that most of the problems were of a wave transmission character in mechanical systems and the work was greatly aided by reversing the use of the analogies between the mechanical and the electric circuits to give us explanations of the behavior of mechanical systems in terms of known electric systems.

By designing the acoustic transmission system as the analogy of the proper electrical system, vibrations up to five thousand cycles per second can be passed through. This has been done in the new talking machine and as a result, the higher overtones of speech and music are reproduced, provided, of course, that they are present in the grooves of the record. The radical improvement in the reproduction has been obtained, not only by improving the reproducing machine but also by improving the record to cover the requirements mentioned.

Turning to the region of the low tones, transmission theory shows that here again there is a cut-off point for the acoustic transmission system determining the deepest notes which can be given out. There is a definite relation between the rate of taper of the horn and the size of the opening of its large end for a predetermined low limit of tone. In the new talking machine a much larger horn than those used in the past has been incorporated and has been designed to fit into a cabinet of commercial size. The horn is folded on itself and by making the bends at places where the sound path is narrow it has been possible to effect this folding and still maintain the correct design.

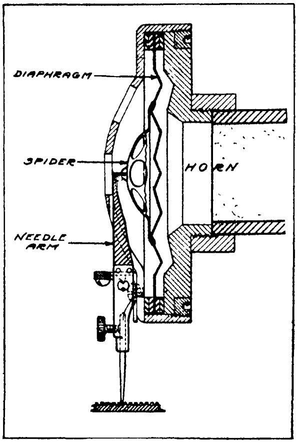
When this horn is so designed that the mouth opening is large enough to radiate all notes which reach it, there is obviously no reflection at the mouth and hence no fundamental resonance of the horn. Since the rate at which the horn tapers or flares determines the lowest note or frequency which reaches the mouth, it is seen that such a horn can easily be designed.

Harmonics Reproduced in Wide Range

The improvements which have resulted from the new method of recording and the newly designed talking machine are quite marked. There are three important ones. First, and most striking, is the reproduction of the bass and the higher harmonics. The reproduction of the bass, that is, the lower frequencies, adds the "body and weight" to the music which has been missing in the past, while the reproduction of the higher harmonics introduces a definition or detail which has also been lacking. This improvement in definition coupled with the rendering of the lower notes has made possible the reproduction of very large orchestras and choruses which has heretofore been almost impossible. As mentioned previously, it has also produced the illusion that the artist whose record is being listened to is right out in the room with the listener.

The second big improvement is the addition of the "atmosphere" surrounding the music, that is, the sense which the listener has that the music has been played in a room or a hall.

The third improvement relates to the apparent loudness. Although the new machine gives one a sense of being louder than the old types, it never irritates the ear as was the case with many of the old reproductions. This is because the apparent increased loudness has been obtained by adding notes which were not reproduced at all or at least very poorly in the older machines, and not by making those notes. which were reproduced well before, louder than they were. In fact the notes which were reproduced most loudly on the old machines are not as loud on the new machine as they were on the old.

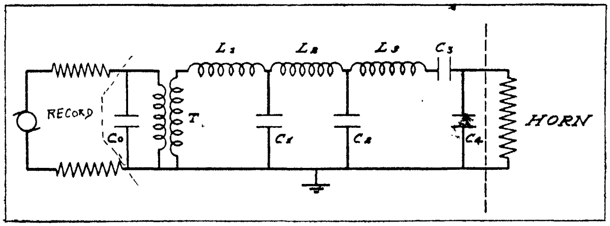


THE REPRODUCER

The corrugated diaphragm and the fingered spider that bears thereon register the sound vibrations

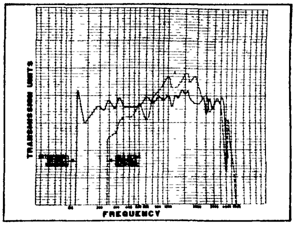
It is important to remember that while this new machine is a considerable improvement over the older type, this improvement could not be completely utilized if new methods of recording had not been developed also. The new methods of recording employ high quality "pick-up" apparatus, distortionless vacuum tube amplifiers and an electromagnetic means for driving the stylus which cuts the original record. The result of this new process of recording has been two-fold—first, notes ranging from the low bass up to the higher harmonics have been recorded; second, the acoustic effects of the studio which produce the so-called "atmosphere" surrounding the music have also been recorded, in the graded manner previously noted.

When all of these results have been accomplished in the artificial reproduction of music and speech, the listener seems to "feel" the presence of the artists to whose record he is listening. There is a noticeable depth and carrying quality, not previously appreciable. To complete the illusion, it would be necessary for the listener to see as well as hear the artists. While this latter requirement has not been fulfilled in any way, the illusion produced is so good that the reproduction is raised from the class of minor amusement to that of an artistic production. Telavision promises to complete the illusion.



A TRANSFORMER OF RATIO EQUIVALENT TO THAT OF THE NEEDLE ARM

Coil L1 represents the effective mass of the needle arm, C, flexibility of arm tip, L2, mass of spider, C2, flexibility of spider legs; L3, mass diaphragm; C3, flexibility of diaphragm edge, C4 compressibility of air between diaphragm and back-plate



THE OLD AND THE NEW

These curves show the comparative loudness of the old and new types of phonograph over the frequency range

All photographs courtesy of the U S Bureau of Standards

A group of ice flowers showing how they grow out from the stem of the plant These were formed upon stalks of dittany

Ice Flowers

Phantom-like Blossoms Appear at the Roots of Plants and Disappear with the Morning Sun

By Nell Ray Clarke

SOME of the wild flower families are not satisfied with doing their bit to make the world beautiful during the spring and summer. When Jack Frost begins turning the leaves brown, these plants bloom again down near their roots in queer white blossoms.

The blossoms are phantom-like, now they are visible and then they disappear. Sometimes they are tied with satiny white ribbons like a bridal bouquet. In the morning they are at their best, but when the sun peeps over the horizon's rim, they fade away before your very eyes The slug-abed and the victim of apartment house life and paved streets never sees them and seldom knows they exist; but the rambler over field and wayside, who loves the crunch of frost beneath his feet, is familiar with them Sometimes he calls them by such an unromantic name as "ground ice"; sometimes they are called "frost flowers," or "ice fringes"

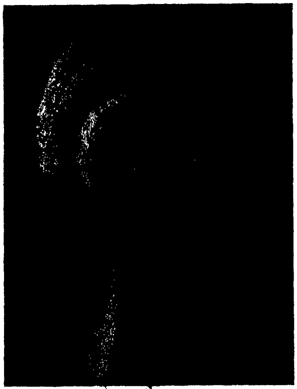
They Bloom on Frosty Mornings

Many of our annual plants with perennial roots "bloom" in this manner during the fall The thistle and the stumps of the heliotrope, "rock mint," or dittany, flea bane and other plants produce the flowers. Sometimes these fringes of ice form in the cracks of trees, and between the bricks of old sidewalks.

They are to be seen on cold frosty mornings in November to January when there is plenty of hoar frost but when the earth beneath is not frozen As a rule they range from one to three inches in length and sometimes they grow six inches long They assume complex and sometimes very beautiful forms, varying enough to stimulate the imagination to find names for them

Sir John Herschel nearly one hundred years ago described the ice flower as a "kind of riband, or frill shaped, wavy, friable semipellucid excrescence, the structure of which is 'fibrous,' like the fibrous variety of gypsum, presenting a glassy, silky, wavy surface, the direction of the fibers being at right angles to the stem, or horizontal."

For some time early-rising scientists argued among themselves as to the real cause of these ice flowers, and several of them held for years that they were formed on the outside of the plant stem just as frost is formed on the window pane—by the formation of ice spicules as the result of the deposition of moisture from the surrounding air.



AN ICE FLOWER

A thing of graceful beauty which vanishes quickly

Dr. W. W. Coblentz, physicist of the United States Bureau of Standards, who for years has been watching the frost flowers which form on plants in Rock Creek Park in Washington, has another theory concerning their origin. He has also made detailed experiments to support his belief that the water for the ice flowers comes from the plant itself

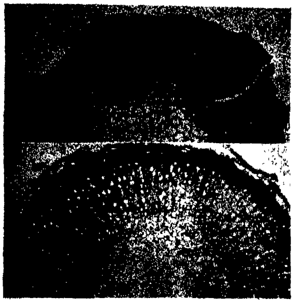
Botany wasn't especially in his line; but he first became interested in ice fringes when he noticed beside the road what at first looked like a rosette of white satin ribbon which might have been thrown there from some passing automobile or carriage. Then he noticed that the white fibrous loops and ribbons were fastened firmly upon a dry twig and that they were made of ice. So he bundled the specimen up and sent it to one of the professors at the United States Weather Bureau. The professor was interested and suggested that Dr. Coblentz make a study of such ice formations.

Dr. Coblentz' Experiments

Before beginning work Dr. Coblentz looked up the matter and found that John Le Conte, while studying plant life in the lowlands of South Carolina and Georgia, had noticed such fringes and had expressed himself as believing that they came from the pith of the plant Dr. Coblentz did not accept Le Conte's explanation, however, because he had noted the fact that the ice was always formed on the outside of the stems and never on the pith. And then his experiments began.

He cut a bunch of dried stems of the dittany (Cunila mariana) which has a great number of sap tubes in the stalk. He broke them off about four inches in length, peeled the bark off some of them and mounted them in a heavy piece of pasteboard, cemented them in tight, inserted the ends in a glass test tube filled with water and put them out on the window sill on a cold frosty night. He carefully covered the stems with a glass receptacle to prevent the deposition of moisture from the air.

One of the stems had been painted over with a cement which is impervious to water, to keep the water from being drawn up through the sap tubes. It was significant that this stem formed no fringes.



CROSS SECTIONS OF STEMS

Above An aster It has a compact woody structure and few sap tubes Below Heliotrope Note the numerous sap tubes through which water reaches the surface

On the other hand, the stems which had their lower ends immersed in the water did form beautiful fringes.

This was conclusive proof to Dr. Coblentz that ice flowers are formed by water passing through the stems of the plants and freezing on the outside, or as he puts it, by "capillary action." He argued that the water for the ice fringes upon growing plants comes from the sap, though the solid contents of the sap which give it its taste or color do not reach the surface, for the ice is tasteless in spite of the fact that dittany, or "rock mint," has a strong fragrance of thymol.

"The amount of ice formed upon a plant stem," said Dr. Coblentz, "is dependent upon the rate at which the water can rise by capillary action in the sap tubes within the stem, the ease with which the moisture can pass out to the surface, the rate of evaporation from the surface (dependent upon the wind and other factors), and the texture of the surface of the stem—whether it gives out the sap freely."

For the average individual the question would have been settled with the first experiment, but not for Dr. Coblentz. He clung to his theory that the water traveled up the sap tubes, but in order to prove that it didn't creep up along the cambium layer of the plant, or the bark as we would say, he made a few more experiments with his test tube.

He took several dried stems of the dittany and covered them with shellac and he found that they formed no fringes—again conclusive evidence that the water for fringes had to come from within the plant. The shellac had prevented its coming to the surface.

Next he took some more dried stems and fixed them in a test tube as before, but he cemented their sides over with a substance which would keep any moisture from creeping up on the outside of the stems or along the bark. To make assurance doubly sure he put some red dye in the water in the test tube. Next morning the red dye was creeping out at the top of the stems, showing conclusively that it had made its way during the night through the entire length of the stems *by way of the sap tubes; for the sides of the stems had been cemented over* and it was therefore impossible for the water to rise in any other way

Another proof of his contention was that in each case considerable water had disappeared from the test tube The glass beakers covering the stems were perfectly clean, showing that no water vapor had condensed upon them. Evidently the ice fringes had been formed from the water that had disappeared from the test tube.

Moisture Flows Through Sap Tubes

"One of my most interesting observations in this experimental work," said Dr. Coblentz, "was the formation of the ice fringe from its very beginning This was also watched by several of my colleagues in order that they might verify my observations. We placed some of the stems mounted in cardboard with their ends immersed in water on the window sill one cold morning In about 20 minutes, the ice began forming. It consisted of a row of fine hairs extending up and down a length of about four millimeters of the stem and projecting horizontally. They were visible only when viewed against skylight and they melted immediately when the glass cover was lifted.

"The fringe did not appear to form at the line where the pith is closest to the surface of the stem.

"Within half an hour after placing the specimens in the cold air one stem showed several fringes in the form of thin transparent 'teeth,' each one being about 12 millimeters in length Another stem showed a fine hairy fringe which was visible when viewed against gaslight Within half an hour this hairy fringe appeared to be solid, with some of the fine hairs extending horizontally outward through the solid 'tooth' of ice By the next morning numerous wide fringes had formed on the stems, and in one instance had pushed out a narrow strip of the bark away from the stem, a thing which often happens in such formations.

WHERE ICE FRINGE FORMS

Here is a bunch of dittany or "rock mint," a small perennial American herb From November to January this plant produces beautiful ice flowers down near its roots

"It was obvious that the fringe forms some distance up the stem, at a point where it cools quickest and where the moisture has risen to about its maximum height.

"We also discovered from later experiments that at no time did ice form on the pith, and that the ice fringe did not always start at the 'corner' of the stem where the wood is the thickest, nor did it start at that part of the stem where the wood is thinnest, but at the point where the sap tubes lie nearest the surface—where the moisture can be most easily supplied.

"Ice flowers will also form on pieces of unglazed pottery, like the ordinary red clay flower pot, when it is found lying upon wet soil I have observed in several instances a column of ice an inch high upon such fragments.

"The location and the amount of the ice formation is evidently determined by the ease with which the moisture can be supplied from within the plant, and it seldom forms when the ground is frozen solid, or when there is much wind which would cause rapid evaporation from the surface of the stem"

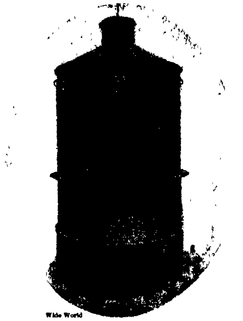
ETHEREAL, PHANTOM-LIKE BLOSSOMS

A group of ice flowers similar to this one may be seen in the woods or in a city park

HOW ICE FLOWERS ARE FORMED

The water in the sap, forcing its way to the outside of the stalk, pushes the bark away

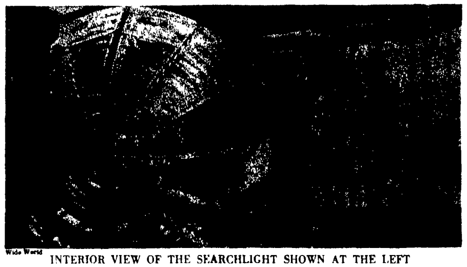
From the Scrap-book of Science—C nera Shots of Scientific Happenings



Wide World

SEARCHLIGHT VISIBLE 300 MILES

In France a great airplane-guiding beacon whose beams will be visible as far as southern England and northern Italy has been installed



Wide World

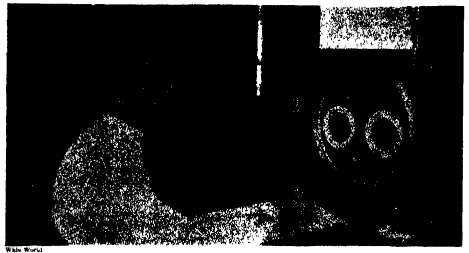
INTERIOR VIEW OF THE SEARCHLIGHT SHOWN AT THE LEFT

During the World War, airplane squadrons sent on bombing missions over the enemy lines often went astray while attempting to return in the dark. France built a mammoth beacon, visible for hundreds of miles Today it is used to guide peacetime aviators

Wide World

IMPORTANT WORK OF T UREAU OF STANDARDS

When the physician makes a blood count in or diagnose your case, he uses a small device divided into chambers. To check up, in turn, e accuracy of these devices, the Bureau of Standards has perfected an ument of great precision



Wide World

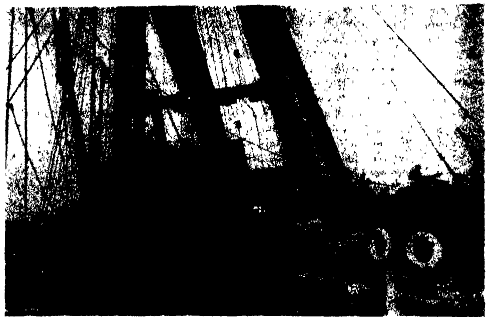
THE "BRASS-BRAIN" AUTOMATICALLY PREDICTS THE TIDES

In the laboratory of the Coast and Geodetic Survey, at Washington, there is a remarkable scientific instrument which predicts the time of ebb and flow of the tides in any seaport of the world. Automatically, it does the work of sixty mathematicians

Wide World

THE LARGEST CAMERA EVER BUILT?

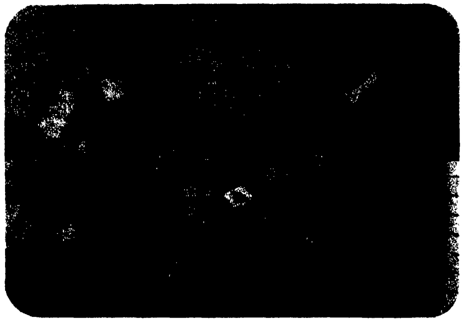
The giant "still" camera, pictured above, which has a lens about two feet in diameter, was recently displayed at an exhibition in Berlin



Kadel & Herbert

STRAINING TO RAISE THE SUNKEN SUBMARINE S-51

Shortly after the S-51 sank off the coast of Rhode Island, two heavy floating derricks were made fast to the damaged submarine Although both vessels lifted every ounce their stability permitted, the water filled submarine was not moved. The Monarch *is here lifting 250 tons*



Wide World

NOTED BUREAU OF STANDARDS PHYSICIST IN HIS LABORATORY

Although this picture shows Dr W W Coblentz killing germs with ultra-violet rays, his recent measurements of the temperature on Mars, in which daytime temperatures of 45 to 65 degrees Fahrenheit were found, is the work for which the public knows him best

ide World

CAN A GIRL BEND A FOUR-INCH STEEL SHAFT?

t the Bureau of Standards in Washington, D C, there is a short piece of steel shafting, ounted on two end supports. Even the pressure of a fingertip bends the bar a few millionths of an inch, and the interferometer accurately indicates the result

International Newsreel

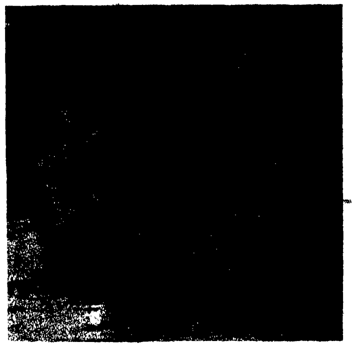
A MODERN MINE RESCUE TEAM READY FOR ACTION

Here is a mine rescue team in Pennsylvania, ready to enter any mine where fire, cave-in or explosion has entombed the miners. Three of the members wear gas masks, the rest wear more special breathing apparatus. All carry the most modern safety lamps

Wide World

FILMING A SURGICAL OPERATION

Under a Berlin motion picture camera, a surgical operation may be filmed, so that medical students may witness the operation later



Wide World

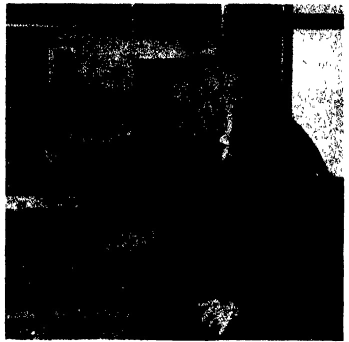
TO TAKE "MOVIES" OF SUN'S ECLIPSE

Captain Barnett Harris, U S. R., of the Harvard Eclipse Expedition will take motion pictures of the total eclipse in Sumatra, January 14th

Fotograms

BLOOD TRANSFUSION LECTRIC POWER

A motor operates the syringe which aids the heart of nor of blood to pump blood into the blood vessels of the patient. This new apparatus was ted by Dr. A. L. Soresi, of Brooklyn



International Newsreel

AMERICAN PHYSICIST FINDS NEW RAY

Dr R A Millikan, who won the Nobel Prize for weighing the electron, has found a new ray of 10,000,000 times the frequency of light

International Newsreel

AIR RAID DAMAGE JUST REVEALED

"Now it can be told," is the admission of the British Government which has just released photographs showing Zeppelin damage in London

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts

Conducted by Albert A. Hopkins

Untangling the telephone cord

Makes a Kinkless Telephone Cord

DOES your telephone cord kink? On this page we show a simple method of rendering it kink proof A series of wire loops constitute a device which is attached to the cord by means of pliers or even a coin With it applied, you can always pull the cord out full length, but it will always snap back when you put the telephone down

A Shop from the "Five and Ten" Cent Store

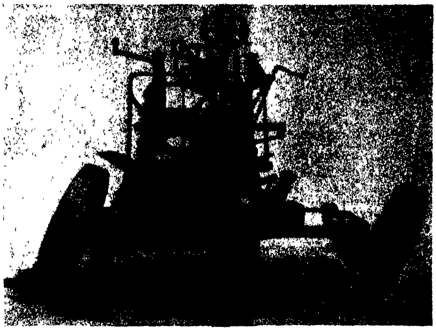
WE show here a pretty good looking and an exceedingly useful shop Every article came directly from a five and ten cent store It is not claimed that every article can be bought in every "five and ten" —far from it The tools came from shops bearing five different names These stores vary their stocks right in the same city For example, the writer went to a well known store near his home and secured about six or seven tools, yet one of the same name near the Woolworth Building would have produced thirty or more tools The cost of all these tools was exactly five dollars, and the extra supplies cost about two dollars more. The vise for ten cents is a real wonder, and the tap and holder for twenty cents is a rare bargain A shop like this can be installed in any house after a few visits to our fixed priced stores

A Twine Cutter Worn Like a Ring

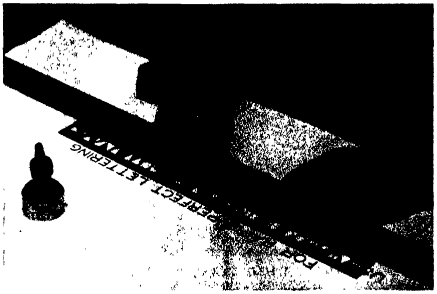
THE new twine cutter illustrated on this page may be worn on the finger even when the user puts his hands in his pocket The blade can be sharpened when it becomes dull, or a new blade can be put in by driving out the holding pin. This latter operation is accomplished by loosening the flat spring with a screwdriver, and turning the blade to the left.

A hand power kitchen "slavey"

What $5 will buy in the five and ten cent stores



A road grader with leaning wheels and a telescopic rear axle carried in a dust-proof steel housing



First aid to the draughtsman

A twine cutter that fits the finger

A Novel Road Grader

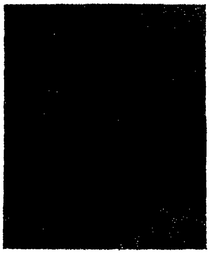
THE outstanding feature of the new grader, shown on this page, with leaning wheels, is the telescopic rear axle. Separate cranks near the operator control the right hand and the left hand extensions. The axle is carried in a dust-proof steel housing in which the gears controlling the telescopic movement run in oil

A Mechanical Assistant for the Kitchen

WE show here a hand power combination machine for saving time in numerous household tasks which will whip cream, extract fruit juice, beat eggs, and even sharpen knives There is said to be no splashing or spilling of the contents. Its work is done by means of a number of attachments, which may be changed in a very few minutes It can be attached to table, counter, cabinet, or window sill

An Aid to Rapid Lettering

THE lettering guides shown on this page insure rapid and more perfect lettering for the commercial artist or architect The guide is first placed in the position needed with its upper or lower edge in contact with the edge of a triangle, T-square or other straight edge. Each character is formed by following the edge of the proper opening in the guide with a special pen provided with the outfit. This special pen has a plunger in it and the flow of ink is controlled as needed No pressure on point of pen is necessary



A rotary whisk broom

An extension leg for the ladder

A Ladder for Queer Places

AN extension leg for a ladder that will prevent accidents when the ladder is used on a sloping roof or steps or other uneven surface has been recently invented. It is a metal part that is attached to a leg of the ladder; and it may be adjusted in a few minutes. The extension is firmly held at any desired point by strong set-screws and rests on an angular end that does not mar the surface. The extension can be adjusted to any length from one to fifteen inches. Two advantages are that it does not mar the ladder as would a block nailed to it; and it is much safer. When the ladder is placed on steps, the extension part can be lowered to rest on a step or two below the one on which the other leg is placed.

Letting the Vegetables Breathe

THE device shown is a cabinet that permits the entire supply of vegetables and much of the fruit that is brought into the house to be assembled in one convenient place, thus eliminating unsightly boxes, bags and baskets that take up room and create the appearance of disorder and untidiness. The air, which all vegetables must have, is allowed to pass freely around the contents. This keeps them fresh, full flavored and free from decay. There is no expense of upkeep as there is in providing ice for the refrigerator.

Combination stool used as step-ladder

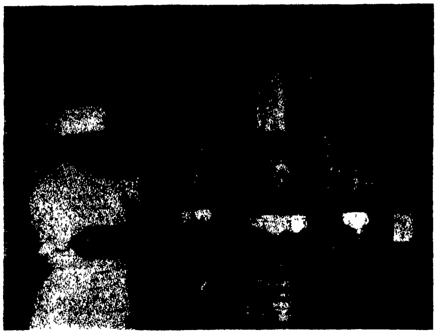
A vegetable safe keeps vegetables and fruits in good condition

Percolated Coffee from the Urn

AN Italian concern has developed a multiple percolator for the coffee urn. Three of the percolators are shown in the illustration. Three cups can be filled from each percolator at the same time.

New Comfortable Air Cushion for Motor Cars

THESE two cushions are designed for motor car owners who would avoid fatigue and eliminate shocks, jars, and other vibration. They are made of rubber, and are to be inflated. Like the balloon tire very low air pressure is used, making a soft flexible seat and back, with a maximum of comfort. They are made to cover front and rear seats and back cushions of automobiles.



An Italian percolator makes from three to twenty-one cups of coffee continuously

An air cushion for the seats and back cushions of automobiles

A holder for the automobile cushion

A Picnic Seat Carried in the Auto

HERE is the picnic seat you have been looking for. A universal support made to fit every cushion in an automobile. It is made of metal, folds flat, and it is carried beneath the seat itself when not wanted. It adds a touch of comfort to your outing.

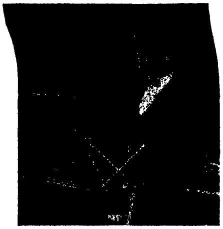
Doubling the Use of the Kitchen Stool

A HANDY device for the kitchen is a combination stool which when reversed becomes a step ladder to raise the housewife to a moderate elevation. The construction is admirably shown by the photographs. The steps are covered with rubber to prevent slipping.

Ford Plants Immaculately Clean

A RECENT visit was paid to the Ford plants at Detroit, and it was found that, without question, they are among the most remarkable plants in the world. Not only are the power houses up-to-date, but they are places of immaculate cleanliness. The firemen dress in white uniforms, and the shovels, slicers, et cetera, are nickel-plated and are fastened to a frame with the order and precision of an exhibit in a museum. Powdered coal is used throughout the plants.

The step-ladder becomes a seat



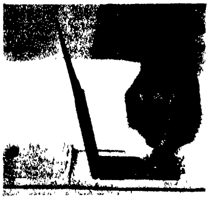
An aid for the study hour

An Adjustable Lap-table

THIS adjustable table is twelve inches wide and eighteen inches long. It folds up to the thickness of an inch It may be locked in many different positions

A Novel Bath Tub for Babies

THE combination bath tub and dressing table for the baby illustrated on this page will fit over any ordinary bath tub When not in use it may be folded up and put out of the way The tub part is made of rubber with a hole for waste water



Fingerprinting attachment for check books

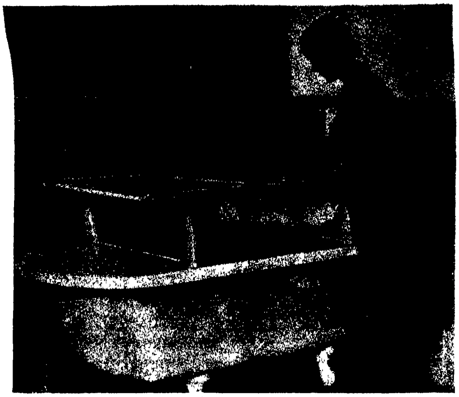
Fingerprinting Checks

THE fingerprinting outfit illustrated provides a convenient inking pad and a pad containing a cleansing cream for cleansing the finger after the print has been placed upon the check

A New Hack-saw Blade Holder

THE accompanying photograph shows a recently invented hack-saw blade holder It consists of a single piece of steel rod, one end of which is bent into a handle The rod is provided with a groove which receives the upper, unserrated edge of the blade Near the handle is a small section parallel to the grooved length and having a flattened surface which grips the teeth at the rear end of the blade To remove or insert a blade, it is necessary to spring the free end of the handle portion slightly outward from engagement with the teeth.

Comparison of the umbrella opened for use and closed



Combined bath tub and dressing table for babies

A new holder for hack-saw blades

A portable machine for measuring light

A comfort to the sick

A Stropper for Safety Razor Blades

SIMPLICITY is the most desirable quality of a safety razor stropper On this page we illustrate one that has simplicity Roll the roller across your hand; the roller strops the blade The hand supplies the oil.

A universal stropper for razor blades

A Simple Device for Measuring Light

THE "lightmeter" shown on this page is made up of three principal parts—the telescopic head, a small lamp and battery with their housing; and a rheostat, switch and voltmeter assembly. The operator, in viewing the object, moves the lamp and battery housing in or out until the two ellipses seen through the telescope match in brightness Graduations on a scale engraved on the tube then give the intensity rating of the light

A Practical Folding Umbrella

AN umbrella, illustrated on this page, that will fold into a roll ten inches long and two inches in diameter has been invented and perfected by an inventor of Pueblo, Colorado The handle telescopes and with a few turns of the telescoped handle the top folds The outer half of the top hinges up and the inner portion of the top folds down. The opening is made automatically by releasing a spring.

Close-up view of collapsible umbrella opened and closed

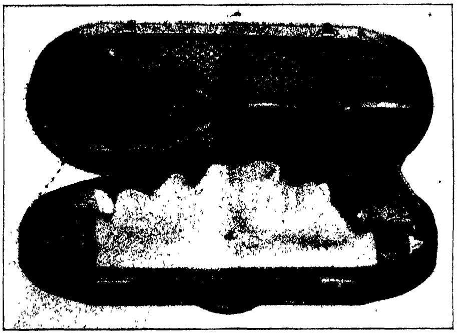
Stepping off the pneumatic elevator

Stairways are Eliminated

THE accompanying photos show an efficient time-saving system in use in the pressroom of the *San Francisco Chronicle*. As shown in the right-hand picture, a pressman lays his hands on a smooth steel shaft rising perpendicularly from a hole in the floor and disappears from sight. A moment later (as shown in the foreground of left-hand picture), a pressman pops up through *an adjoining opening and steps out on the* floor. In this speedy way, pressmen pass between the press floor and the paper reels in the basement below. The workman slides down a pole (similar to those used in fire houses), and to return, he steps on a one man pneumatic elevator which automatically rises to the pressroom level and drops back as he steps off. This equipment saves the pressman a total of about three hundred trips daily up and down stairways.

First Aid for the Tennis Player

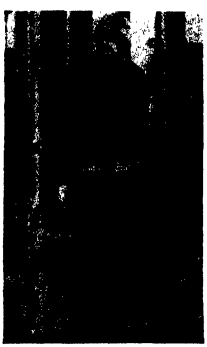
AT last somebody has invented a carrying case which the tennis player will welcome with pleasure. The case conforms in a general way to the shape of the tennis racket, and there is ample space for sweater, balls and shoes. The racket is tucked out of the way in the cover.



A tennis multium-in-parvo

A Safety Automatic Exit Door for Street Cars

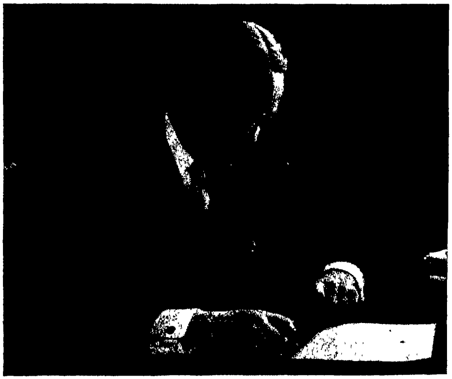
TO promote safety, automatic exit doors are being installed on some Chicago street cars. These doors do not open until the car comes to a stop, and they cannot be closed until the passengers are off the steps. An entirely new principle is put into practice in this door in that the weight of the passenger on a steel plate inside the vestibule opens the door, but not until the car is at a standstill. When the passenger steps off the exit step, the removal of his weight causes the door to close again. The doors require no attention of the conductor and are designed to promote safety where conductor and motorman constitute the crew of the car, or for one man cars, or for cars where two or three are moved together in a train. Already one hundred of these new doors are being used in Chicago. The system is operated by compressed air.



Automatic exit door

Speedy Signature Blotter

A NUMBER of blotters are secured to a desk ruler. This device is not new, yet we thought it worth showing.



A handy signature blotter for the busy man

Sliding down pole to basement

Help for Monday

"BLUE MONDAY" can be made a cheerful day if you have a clever mechanic around the house who still owns a bicycle—or even the remains of one with the rear wheel working. Of course it is not quite so simple as it might seem because you must have a washing machine too.

A new use for the old bicycle

An Abbreviated Lawn Mower

HOW many times have you thought, "If my lawn mower were cut in two in the middle, and the sawed-off ends of the blades run along the house wall or the fence, it would clean the grass right up to the edge and save that tiresome trimming with sickle and shears?" To meet this condition a manufacturer has cut a lawn mower in two in the middle, provided a strong plate and outer bearing for the shaft of the cylinder and suitable bracing. There has also been provided a sharp-edged disk with a little plowshare to throw aside the "edgings." It not only cuts grass, but slices sod, evens up margins, and cleans edges.

A lawn trimmer

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Courtesy General Motors Co

Showing the special provision for taking up the side thrust

Some Features of 1926 Motor Trucks

IN our January issue, Mr W H Slauson outlined some of the features of the 1926 automobile, and it will be of interest, therefore, to call attention to some of the developments which will be noticeable in automobile trucks

Perhaps the most radical line of advance of all is the adaptation of the Diesel engine to commercial operation Shall we drive our trucks, and possibly our motorcars, with Diesel heavy-oil engines? It begins to look as if this advance were due to arrive within a few years

The Diesel engine has always been considered hopelessly heavy for such service Owing to the high compression involved in this type of motive unit, and to other reasons, it has been necessary to provide great strength and rigidity in the structure of the engine itself, and this, in turn has involved great weight Ways have now been found to make the Diesel engine available for truck service, while experiments are being made at Langley Field with ordinary Liberty airplane engines altered into Diesel engines The results however in the latter instance have so far been unsatisfactory

What are the characteristics of the Diesel engine that make it more desirable, for certain work, than the gasoline engine? For one thing it burns low grade oil, although this is not its distinguishing feature Its unique feature is the fact that the fuel is ignited by heat generated when air is compressed in the return or compression, stroke, therefore no spark plugs or other similar ignition apparatus is required

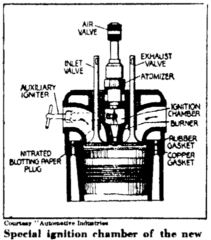
Have you ever noted how hot a tire pump becomes? This is not due alone to friction but largely to the heat engendered when the air is compressed If you take a cubic foot of air and compress it into one-half cubic foot space, you have given one half cubic foot of air the quantity of heat that formerly existed in one cubic foot

Now this is what happens in the Diesel engine The air that is forced into the cylinder during the cleaning or scavenging stroke is compressed, on the return or upward stroke to about one thirteenth of its original volume, or to about 450 pounds per square inch This automatically raises its temperature to 800-1,000 degrees, Fahrenheit At the moment of highest compression, a spray of fuel oil, under still higher outside pressure is injected into the combustion chamber and small clearance space between the piston and the cylinder head Combustion now takes place at once

The high pressure is not, however, rapidly reduced as the piston travels down, as is the case with the ordinary gas engine, but since the fuel does not explode but continues to burn through a part of the stroke, the pressure is in a comparative sense maintained This is why a Diesel engine is called a "constant pressure" engine It is in a measure like a steam engine.

The ordinary gasoline engine consumes about one pint of fuel per hour per horsepower, while the Diesel engine delivers one horsepower during one hour on one half a pint of low grade oil, or on even less than this The advantage of introducing this type of engine into regular motorcar and even airplane service is obvious, provided the necessary adaptations can be made successfully This problem now greatly interests automotive engineers

Two years ago, says *Automotive Industries* (New York), the Benz works of Manheim, Germany, first exhibited their automotive type of Diesel engine and Diesel engines are now being regularly produced both for motor trucks and tractors



Courtesy "Automotive Industries

Special ignition chamber of the new Diesel truck and tractor engine

This engine has a special ignition chamber and fuel atomizer which works under an outside pressure of 1,000 pounds per square inch The illustration above shows the various parts Gas oil, yellow and brown paraffin oil, tar oil and crude oil, including Texas oil, can be used providing the viscosity is not too high

The truck type of Diesel engine has four cylinders instead of the two used for tractors, also an electric self starter The bore is 4 93 inches, the stroke, 7 09 inches The consumption of fuel is stated to be .53 pound of fuel per horsepower hour

The Langley Field experiments with a Diesel engine for airplane purposes are being reported in two articles in *Power* (New York) and are too long to summarize here Editorially, *Power* says that although a Diesel aviation engine can not be made of a converted gasoline engine (the experiments apparently tore a Liberty engine to pieces pretty quickly the brasses, journals and so on "going out" under the greatly enhanced stresses) the work that is now being done points the way to ultimate success

It is a long way from the extremely heavy Diesel engine used for stationary and marine purposes to a Diesel engine light enough for aviation, but this is a development which may be expected in the near future

Another feature which materially affects the life of the truck motor is the elimination of vibration by means of three point suspension, where the center point is the forward end An extension of the timing gear cover, through which the hand starting crankshaft extends is carried in a bracket mounted on a cross member of the frame This bracket is bored out to a larger diameter than the starting crank housing; a rubber ring fits the housing and is contained in the bored recess of the supporting bracket This acts as an insulator at this point The assembly is shown in the accompanying illustration

The two rear supporting points are arms or lugs extended from the fly-wheel housing Interposed between the bracket on the frame and these arms is a rubber insulator biscuit inclosed between two stampings, which have extensions turned up on them which register both in the bolt hole in the bracket and in the motor arm This takes the side thrust

Removable cylinder sleeves in the motor itself permit the replacement of scored cylinders within an hour's time without demounting the cylinder block Thus, standard dimensions are maintained for piston and ring and the laborious and costly grinding of cylinders to oversize, installing oversize pistons, and so on, is eliminated, time and expense are thereby saved In addition to this, the separate sleeve is made of harder metal having a better wearing surface, and the cylinder walls are of uniform thickness and homogeneity, for they are machined all over and show uniform expansion under the heat of the explosive gases This uniform expansion permits closer limits in the fit of the pistons, which in turn means longer life and a more efficient work cycle Further, the crankcase and cylinder-carrying block are cast in one piece, thus making for lightness and for the better distribution of metal

The accompanying illustration shows the gaskets at the top and bottom of the cylinder sleeve, which make the water-jacket tight, also the one piece casting feature of the entire engine, and the rear suspension lugs on the side of the motor

Courtesy General Motors Co

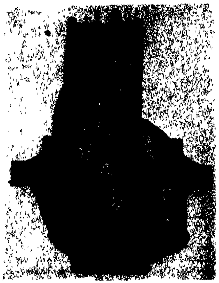
Three-point suspension (note bearing under the front of the engine) eliminates much of the vibration

• • •

Power from the Wind

IN sections of the country where there are fairly steady though not necessarily high winds, with few calm spells, a windmill driving an electric generator, with a storage battery floated on the line, has made good Several of our readers have inquired why such equipments have not driven gasoline-electric power units entirely off the market The gasoline costs money, they argue, while the wind is free.

If this were the whole of the matter there is little doubt that the wind equipment would be the survivor But there are several considerations not immediately apparent, which offset the superficial factors. Undoubtedly, howevet, the natural inertia of human beings has helped to some extent to prevent the development of the windmill-electric equipment, for the gasoline equipment is well established It has proved satisfactory and its over-all cost is very little more than that of the wind equipment.



Courtesy General Motors Co

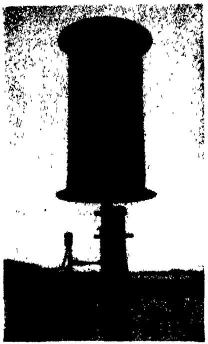
The crankcase and cylinder-carrying block are cast in one piece

In one of the Annual Reports of the Smithsonian Institution there is a paper on wind power, in which several fundamental windmill considerations are taken up, the more pertinent of which interest us here The common American type of windmill develops about twelve percent of the available energy of the wind Taking the average of seven weather observatories near the western and southern coasts of the United States, a wind velocity of four miles an hour and upward is experienced during about 7,500 out of the 8,760 hours of the year, while the velocity most frequently noted is fifteen to seventeen miles an hour In the East, and inland, there is just a little less duration than that just given, but the prevalent velocity is lower, being between eleven and thirteen miles an hour

In the November, 1924, issue of *Mechanical Engineering* (New York), the official organ of the American Society of Mechanical Engineers appeared an article, "Wind Power for Farm Electric Plants," in which the statement is made that, according to the United States Weather Bureau, the longest calm or period of continuous low wind velocity below five miles per hour, is thirty-

Courtesy "The Engineer"

The aerodynamo, a new type of windmill with blades designed on the airplane principle. The wind is blowing away from the reader



Kadel & Herbert

This is the Savonius wind-motor, invented by a Finn. A plan of the same rotor is shown below, right half

four hours for the Middle West, varying with the locality Power can be generated in all winds above five miles per hour, but the ordinary type of wind wheel is not efficient for such operation

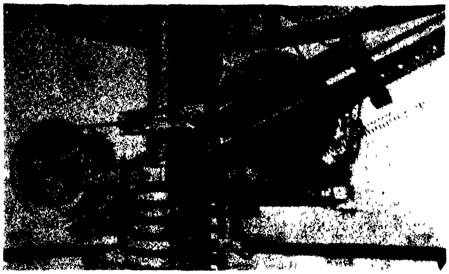
A wheel thirteen feet in outside diameter with blades three feet long, it is stated, will give ample power for an electric plant suitable for a modern farm in the middle west, but the characteristics of a windmill are not favorable for large units, a twenty foot wheel being about the largest size that can be used and give satisfactory result. The first cost, cost of operating, and depreciation compare very favorably with those of gasoline lighting plants

The last sentence quoted is significant, although gasoline costs money, while wind is free, there is not the difference in ultimate or last cost that one would be led to expect

The old Dutch type windmill was extremely inefficient, making use of only three to five percent of the available energy of wind The ordinary American type having sheet metal blades is better, but it will be evident that considerable improvement should be attained in the new development of adapting the thicker airplane blade to the windmill Such a windmill, having aerofoil arms, has been built in Germany, and is now on trial by the Institute of Agricultural Engineering of Oxford University at Harpenden, England.

As a result of researches made and practical experience obtained during and since the war, we now know that it is not entirely the up thrust of the air on the wings of an airplane that keeps it from falling, but rather a combination of the vacuum above the wings and the pressure of the air underneath, that holds the machine in the air It is not wholly the air pressure on the front of a racing automobile that retards it, but a resultant of the suction of the vacuum behind, and the front pressure. It is, again, not the pushing effect of the wind on the sails of a ship that propels it, as has always been supposed, but again a combination of suction and pressure And it is not, as we have assumed for 5,000 years past, the wind that hits the face of a windwheel alone that turns the wheel and performs useful work but the pull of the moving air stream on the back of the wheel and the pressure on the blades. That was the prime discovery of Major Bilau, a German investigator who has made a new windmill blade that utilizes a maximum of the available wind power.

The problem was to develop the incident force on the *back* of the blades, where it could exert the maximum pull. This means, first of all, that instead of making the wheel face the wind, it has to be turned away so that all the other attachments including the vane shall be in front. The wind *leaving* the wheel would, therefore, be free from all



This close-up photograph shows the detail of the generator which is mounted on the Montana windmill shown at right. Note the collector rings, which permit electrical contact in all positions of the windmill; also the motor and pulley

disturbance; the stream line of the air current would not be broken up; and the shape of the blades of which there are only four on the aerodynamo—as it is called—is shell-like, the hollow being turned to the wind The wind striking this hollow is guided by its peculiar shape, over the cutting edge of the blade, which, it will be noticed, is not thin as one would expect, but very thick

A thin edge favors the formation of vortices in the air at the rear edge of the blades These vortices are a retardant, but the thick, curved edge does not permit the formation of such vortices.

In all windmill construction, one of the difficulties has always been the finding of some means of utilizing all ordinary wind speeds from the gentlest to the heavier without risking injury to the machine This is achieved in the aerodynamo blade by a special aerodynamical principle Near the end of each blade will be seen a small projecting "fin"

The fin is situated at a very critical aerodynamical point If there were no fin at moderate speeds all the wind streaming *along* the surface of the tip of the blade would pass off at the sharper edge where it would set up "goat's horn" vortices and thus retard the motion of the wheel When this portion of the air stream hits the fin, however, it is deflected right over the tip of the wheel and does not stream off at all When, however, the wheel is revolving *too* fast, the fins automatically turn parallel with the blade Vortices are then formed at the sharp edges of the blades and these act as a brake

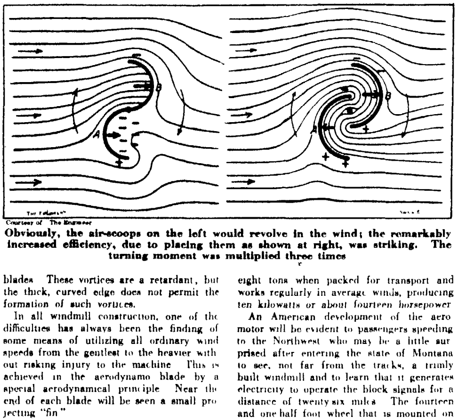
The *electrical part of the aerodynamo is* all contained in the egg-shaped body placed on the windward side of the mill The voltage of the current generated by the aerodynamo remains constant, independent of the speed at which the wheel revolves, while the amperage varies with the speed

The wheel begins to turn with a wind speed of about six and one-half miles per hour and can, it is claimed, safely utilize all wind speeds up to forty miles per hour without injury The size of the storage battery chosen will depend on the winds prevailing at the spot where the aerodynamo is put up, and the amount of current wanted at the farm in question for lighting cooking, laundering, and driving various forms of machinery The first aerodynamo put up near Berlin is fixed at the end of a ferro concrete mast, about fifty three feet high It has a span from tip to tip of the wings of twenty-nine and one half feet, weighs eight tons when packed for transport and works regularly in average winds, producing *ten kilowatts or about fourteen horsepower*

An American development of the aero motor will be evident to passengers speeding to the Northwest who may be a little surprised after entering the state of Montana to see, not far from the tracks, a trimly built windmill and to learn that it generates electricity to operate the block signals for a distance of twenty six miles The fourteen and one half foot wheel that is mounted on this sixty two foot tower would not be of much service for furnishing electricity if it were not carefully designed The blizzards that sweep across Montana and the Dakotas are enough to wreck most windmills This wheel is so designed that when the wind pressure gets too strong, the blades turn and allow the wind to sweep on through without damaging the wheel

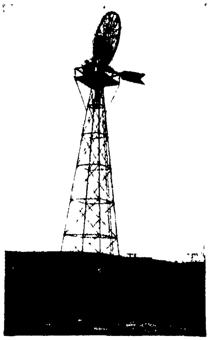
The power outfit has a unique drive that connects the generator to the wind turbine Over the periphery of the wheel is mounted a belt sheave that takes a special weatherproof belt The electric generator is located directly below the wind wheel, easily accessible *The whole installation has maintained* steady, dependable power and foreshadows a broad field of utility

Windmills of the more modern type have had considerable post-war development in Denmark, where large wheels are in use These are not simply the old-style "Dutch" windmills, but are far more efficient machines. Their sails are metal instead of canvas, and they have an automatic self-reefing device to allow for heavy puffs of wind They are made in sizes up to about fifty feet in diameter



Courtesy of The Engineer

Obviously, the air-scoops on the left would revolve in the wind; the remarkably increased efficiency, due to placing them as shown at right, was striking. The turning moment was multiplied three times



A windmill at Culbertson, Montana, generates electricity for operating signals on the Great Northern Railway

The August 21, 1925, issue of *The Engineer* (London) contains an account of a device called the wing rotor This is a device which revolves in the wind on a vertical axis, the metal vanes being curved in the position shown on the right side of the accompanying diagram This wing rotor was developed by Captain Sigurd J Savonius of Helsingfors, Finland

Starting with the design shown on the left, it is self-evident that this would turn in the wind and would develop some power Now if we overlap these sections a surprising thing happens the peripheral speed of the rotor, which in the first type was just equal to the velocity of the wind, goes up to 17 times that of the wind, while the turning moment increases to three times the former case!

* * *

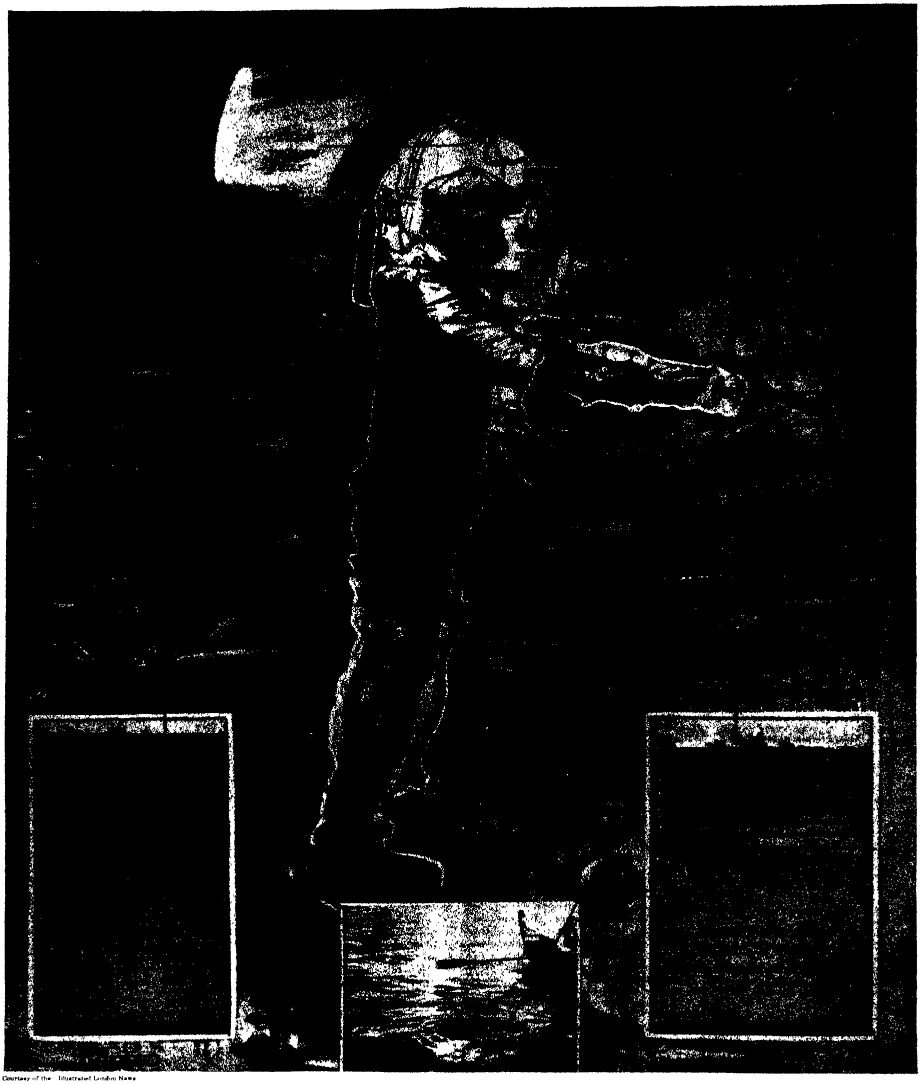
How Did Man Make His Weapons Before the Old Stone Age?

THE January issue of the Scientific American contained on page 20, an interesting article entitled "Men of the Early Glacial Epoch," from the facile pen of the noted British anthropologist, J Reid Moir In it, the author depicted the primitive setting in which man of 500 000 to 1,000,000 years ago dwelt, hunted and fought in a land that now is England

What we know today of these earliest known human cultures the Foxhallian and Cromerian - is chiefly owing to the indefatigable efforts of this writer, Mr Moir Two excellent books written by the same author are "Pre paleolithic Man" and "The Great Flint Implements of Cromer, Norfolk" (both published by W E Harrison, Ipswich England)

Those who enjoyed Mr Moir's article in the January issue and became interested in his depiction of the savage human who inhabited northwestern Europe when it was a sub tropical country before the Great Ice invasion will discover in these works a mine of information "Pre paleolithic Man" is chiefly devoted to a painstaking consideration of the art of flint knapping, and the reader who cares to imitate the stone weapons of primitive man or of the American Indian will find it invaluable as an instruction book

The other book mentioned is an exposition of the Cromer flints, made by a race of men whose hands were obviously greater and stronger by far than those of any living race Some years ago, scientists denied their human origin--said they were accidental products of nature To prove his case Mr Moir wrote this book Science has now accepted the Cromer flints



Courtesy of the Illustrated London News

A Deep Sea Diving Suit to Reach Sunken Submarines

EVERY now and again the world is appalled by the loss of a submarine. Hitherto the sinking of an underwater craft has meant almost certain death for the entire crew, even if the position of the wreck is immediately located in shallow water. Where the sea bottom has been more than 150 feet down however it has been impossible to reach wrecks, owing to the limitations of diving equipment and of human endurance. It is interesting to learn, therefore that for more than a year a firm of German engineers, Neufeldt & Kuhnke, of Kiel, has been experimenting with a deep sea diving suit; and that when, last November, the British submarine *M1*, was sunk with a loss of the entire crew of sixty-eight men, the British Admiralty cabled to Germany and two of these diving equipments were rushed with the greatest possible speed to the scene of the disaster on the British destroyer, *Wolfhound.*

Comprehensive tests in a mountain lake in Upper Bavaria have shown that divers can go down in these suits to a depth of 500 feet, without danger to health or body and without feeling the enormous pressure that prevails at such depths.

From its outward appearance the apparatus

resembles the armor of a knight of the Middle Ages, and is made mainly of Siemens-Martin steel. Sufficient room is allowed in the trunk portion for the diver to withdraw his arms from the sleeves which encase them, to perform any particular operation. At the belt level it is sub-divided into two sections joined by a flange. In front, each side, and on top of the upper section, substantial, closed windows are placed Provision is made for a signaling apparatus, controlling devices, measuring instruments and breathing outfit. (See opposite page)

In the lower sections sufficient space is afforded for the balancing and descending weights, together with seating accommodation for the diver. The covering for the arm and legs is made of a tough aluminum alloy, allowing the diver complete freedom of motion. The limbs of the suit are fixed to the trunk by specially designed, hermetically sealed joints

Universal Trade Press Syndicate

The diver, encased in his pressure-resisting, jointed armor, is being lowered into the water

To insure the greatest possible ease of diving and rising an annular diving tank and two lateral tanks are provided Descents are made by simply opening valves, so that the tanks fill with water When it is desired to get back to the surface, the water is forced out of the tanks by means of compressed air or oxygen

A return descent to 500 feet can be accomplished in four minutes With the ordinary type of suit, operations between the surface and 100 feet occupy an hour Only at that slow rate can a trained diver adjust himself to different pressures at varying depths A battery and six compressed air cylinders at the rear wall of the trunk provide the means of emptying the tanks

A special oxygen bottle and two to four regenerating cartridges, each with a life of two hours, serve to supply the diver with plenty of fresh air Diving with these suits is much safer than with suits of ordinary design

By the new method the diver has a treble connection with the surface—by a line, which in case of necessity is pulled by the diver, by an arrangement for sending out Morse telegraph signals, and by direct telephonic communication with the tender Experiments have proved that a diver can see to a distance of four feet when at a depth of 350 feet; but total darkness prevails at a depth of 500 feet.

The new diving suit opens up a wide field for submarine research, for apart from the reclamation feature, from a purely economic standpoint, the deep sea diving suit will provide greater opportunity for the collection of such commodities as sponges and pearls. It is well known that much larger sponges and pearls exist beyond the present range of fishing activity, than those now obtainable.

Perhaps the greatest advantage of all is that no special training, either technical or physical, is necessary for a man to go down as deep as 750 feet in one of these suits They can thus be utilized at any time and by anybody.

* * *

Literature and Materials for Telescope Mirror Making

OWING to limitations of space imposed by the length of the article beginning on page 86 of the present issue, the following list of literature on telescope making and sources from which materials may be had have been moved over into these pages

Mr R W Porter, the author of the article on page 86, continues as follows

A full account of making telescope mirrors could not possibly be brought within the bounds of these articles Fortunately this is not necessary, for a most excellent book, "The Amateur's Telescope," by the Reverend William F A Ellison, Director of Armagh Observatory, Ireland, has recently appeared, and since the Scientific American has just obtained the right to republish this book in the United States, expressly for this occasion when a large number of American amateurs will need it, it may now be obtained by anyone desirous of making his own instrument

Ellison goes to great pains to explain every step of grinding, polishing and testing, and in describing home made tools that are inexpensive He is clear and concise in his statements I regret that the book is not more fully illustrated by photographs, but those accompanying the present article will help and some assistance may be found in my article in *Popular Astronomy*, listed below

Until the appearance of Ellison's book there was very little available literature on mirror making, and much that was available was fragmentary and scattered The works by Draper, on the construction of a sixteen inch mirror, and by Ritchey, "The Modern Reflecting Telescope," both of which are classics, are now out of print They appeared in the *Smithsonian Institution Contributions to Knowledge* (Volume 34, 1904) and were reprinted in the Scientific American Supplement for December, 1904, and January, 1905 (Ritchey), also July-August 1905 (Draper) These may be found in some libraries, but I am advised that the supply in the hands of the Scientific American was long ago exhausted These articles are not very useful to the tyro An excellent article by the Rev C P Davies may be found in the *Monthly Notices* of the Royal Astronomical Society (listed below) Also, see back files of the magazine *English Mechanics*, which are full of articles and correspondence by English amateurs, of which there appear at present to be many more in Great Britain especially among the clergy, than in the United States This comparative scarcity of amateur astronomers in America may, it is hoped be largely remedied through the renewed interest in telescope making which the Scientific American is attempting to arouse

The available literature on mirror making thus consists of the following

Ellison, *The Amateur's Telescope*, reprinted 1926, by the Scientific American Publishing Co, 233 Broadway, New York, price, postpaid $2 00

Monthly Notices, March, 1909, Royal Astronomical Society, Burlington House, London W 1, England, price, postpaid, two shillings, six pence

The Poor Man's Telescope, by R W Porter in *Popular Astronomy*, November, 1921 Out of print In some public libraries

Knife-edge Shadows, by R W Porter, in *Astrophysical Journal*, June, 1918 Out of print Consult in libraries

Methods of Silvering Glass, *Letter Circular LC 32*, Bureau of Standards, Department of Commerce, Washington, D C, gratis

The following list of sources from which the amateur may obtain materials is not exhaustive and includes merely those firms with whom I have had satisfactory dealings while making hundreds of optical surfaces

Pittsburgh Plate Glass Co., Pittsburgh, Pa., two commercial, polished, plate glass discs, diameter six inches, thickness one inch, ground edges, slightly chamfered, price, about seven dollars

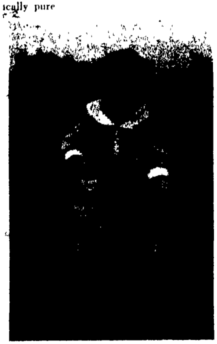
The Carborundum Co, Niagara Falls, N. Y. (branch offices in large cities), carborundum grains, one pound can of each, Nos. 80, 120, 280 ("1 minute"), 400 ("15 minute"), 600 ("60 minute"). Prices range from 40 cents to 80 cents per can, obtain price list Much care should be taken not to contaminate smaller sized grains with grains of larger size

Emery: The Hamilton Emery and Corundum Co, 30 Church Street New York, N Y One pound can of number 6F turkish emery, at fifty cents, post paid

Wilmington pitch may be obtained from some hardware and ship chandler's stores at about 10 cents a pound Any grit contained may be removed from it by straining through cheesecloth while hot An alternative to pitch is rosin (easily secured), tempered to proper degree of hardness by the addition of turpentine

A P Munning & Co, Matawan, N J One half pound of best grade optician's rouge at $1 06 per pound, plus postage

Chemicals for silvering may be obtained from the drug store They must be chemically pure


Courtesy Fresno County Commission of Horticulture

Barefoot boy on a puncture vine. "You people may think this is funny, but I can't see much humor in it"

Lamp Any kerosene lamp can be used, but a small one is preferable since the knife-edge and eye may thus be brought close together I have found it possible to bring the knife-edge within less than an inch of the pinhole when using a little kerosene lamp supplied by The Vapo Cresolene Co, 62 Cortlandt St, New York for 40 cents, postpaid (postage stamps are accepted)

Lastina lacquer 15M, for protecting silvered mirror surface, may be obtained already diluted six to one with amyl acetate, from The Egyptian Lacquer Mfg Co 90 West Street, New York, N Y One half pint $1 00 postpaid Request 6 to 1 dilution

[EDITOR'S NOTE In considering the important question of how the amateur might obtain all the various materials necessary for making his mirrors and mountings with the assurance that the proper kind will reach him, the Scientific American cast about for someone having an intimate understanding of the beginner's needs, who would assume the responsibility of handling them Mr John Pierce, of 11 Harvard Street, Springfield, Vermont, a member of the group of amateur telescope makers and astronomers described in the November Scientific American, was finally prevailed upon to do this work for those of the amateurs who do not make their purchases separately from the several sources named above Mr Pierce is not, however, a regular dealer, but is a teacher of vocational training in the high school at Springfield (Vermont) and he was chosen because he has already made several telescopes and therefore has an exact insight into and a sympathy with the peculiar requirements of the beginner, also because he is in daily touch with the author of the article on mirror making, published in the present issue]

There is a quite prevalent impression that the production of lenses and mirrors and optical surfaces in general is shrouded in mystery, and that the professional producers jealously guard their secrets of manipulating glass While I have found the latter to be unfortunately, true there certainly is no mystery about glass working The sole reason that those capable of producing large optical surfaces in this country is confined to a mere few is the infinite capacity for taking pains which is required If however, the amateur could see the workrooms where Petitdidier McDowell and the Clarks created their masterpieces he would find no elaborate machinery and equipment But these masters are gone and those who remain may be counted on the fingers of one hand

R W Porter

* * *

What Is the Puncture Vine?

A ROADSIDE weed known as the puncture vine, which penetrates the outside of automobile tires is one of the pests with which the California motorist has to contend, according to *California Highways*, a bulletin issued by the California Highway Commission largely in the interest of good roads

With curious intermingling of science and humor, the true scientific name given to the puncture vine is *tribulus terrestris*, it has indeed forced its tribulations upon those who try to cross its foliage, either with motorcar or bare feet Each bur of this peculiar weed bears two sharp pointed spines, and the bur is so balanced that one of the two spines always points upward when the bur is lying on the ground

These burs are about as long, and nearly as stout as an average carpet tack and since five burs make up one cluster, there are on each cluster ten points, several of which are always business end up To complicate the matter still more one plant may bear 10 000 burs, not only to puncture the tire of the car which passes over them, but the skin of him who sits on them

The puncture vine it appears, is not a native American but came over from somewhere in the region of the Mediterranean, as a stowaway, along with ballast in a ship that docked in Texas Since Nature's purpose *in providing this vine with seeds in the* form of burs was to permit them to attach themselves to moving objects for a free ride to a new country, it rapidly traversed the southwest, and seems now to have made its main home in sunny California

Along the highways the puncture vine quickly spread, for the heavy burs picked up by passing motor vehicles were distrib

Courtesy Fresno County Commission of Horticulture

Automobile tires carry the burs of the puncture vine long distances

uted by the same medium The vine is still spreading Fortunately, however, the present-day tire, with many plies of rubber and fabric or cords, is almost immune from actual puncture, but the spines nevertheless, break off in the tread of the tires and work through the fabric when the tire is well worn This shortens the life of the tires

Livestock pick up the burs between their toes, and this often causes them serious infections They even get the burs under their tongues, causing ulcers Grape pickers know better than to kneel in infested vineyards—at least, those who have tried it once know better

Can the puncture vine be controlled? Not entirely Hoeing would be necessary once a week, for the seeds maturing quickly on the vines, sprout at different parts of the season The road grader simply spreads the seeds, planting them nicely under a thin mulch of soil It has been found, however, that various petroleum oils saturate the burs and kill them, and these methods are now being employed in an effort to drive the pestiferous puncture vine off the highways at least of California

* * *

Our Telescope Makers

EVIDENTLY there is a strong latent interest in telescopes and amateur astronomy throughout this country Everybody, seemingly, wants to make a telescope Everybody, at some time during his life, has had the desire to own, not a small spyglass, useful as this type is for learning astronomy, but a telescope capable of doing real, satisfying astronomical work of possible value, in some cases, to science Most of us, however, have had to suppress this desire, we could find other and more pressing ways to spend the several hundred dollars which such a telescope would cost

With these facts in view, it seemed advisable, last summer, for the Scientific American to attempt to stir up interest in the home-making of reflecting telescopes, a type of instrument which, unlike the refracting telescope, can be made by the amateur himself, and which costs comparatively little In order to arouse the interest, not merely of the few who already know more or less about the mirror-making art, but of the many more who may have been misled by the persistent fiction that, since the perfecting of large mirrors requires the work of a born mechanical wizard, the smaller sizes do also, the article, "The Heavens Declare the Glory of God," was published in the November Scientific American, and was purposely kept non-technical

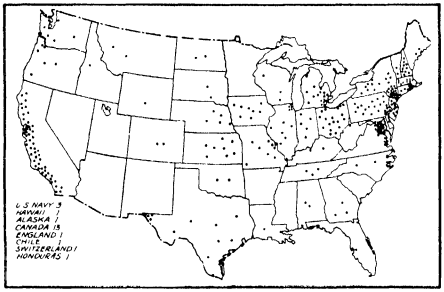
Gratifying, indeed has been the response to it Direct requests for instructions on telescope making were subsequently received from the 314 readers represented by the dots on the map shown in this department of the magazine We may also assume that several times as many more readers will become interested through reading Mr. Porter's article in the present issue, while nearly all of both groups of beginners may be counted on more or less to arouse the interest of groups of local friends in mirror making, thus incidentally making themselves the nuclei of these groups, and possibly of local clubs It is hoped that all who are making telescopes and who have not written to us will do so. We are interested

Thus the prospects are bright for a renewed interest in amateur astronomy in America, just as in Great Britain, where there are—and long have been—hundreds of amateur telescope makers who have learned the art of parabolizing mirrors with fair accuracy and who keep more or less in touch with one another in their work Why should we in America go on permitting them to excel us in this interesting line of scientific endeavor?

Daily for several weeks, a batch of enthusiastic requests for instructions for mirror making have reached our desk and the reading of these letters has shown us who the people are that want to make telescopes, also that most of them are keenly interested They include people in all sorts of occupations young people, old people, professional men and business men, a few women many physicians (whose future patients, calling them suddenly away from their mirror polishing, will wonder why their hands are red with rouge!), a college president, several dentists, a number of youths eager to begin, quite a number of teachers of science with classes which they wish to interest, several lawyers—these are the kind of people, judging by their letters, who want to make telescopes

Courtesy of the Baltimore & Ohio Railroad Co

The largest passenger locomotive in the world, built last June by the Baltimore & Ohio Railroad Company, shown in comparison with a passenger locomotive which is a fairly large type itself



Each dot is a potential amateur's telescope, representing a reader who has written the Scientific American, requesting the publication of instructions for making reflecting telescopes. Up to December 10, there have been more than 300 such requests—count the dots—and more were still arriving. No effort was made to locate the dots more accurately than within the proper states

Here are some more, chosen at random a jeweler, a letter signed by four who will probably work together (four heads are better than one), a dealer in granite, a letter under date line, "U S Air Mail Service" (an aviator?), a Jesuit priest, a schoolboy, a plumber, a Lutheran pastor, the manager of a famous electric lamp manufactory, a man who "has ransacked large libraries in vain" looking for instructions on telescope making (there never have been many, for the literature on telescope making is extremely scanty and has been comparatively unavailable)

Other would-be telescope makers are an electrical engineer a seaman on the airplane carrier *Patoka*, a farmer, a civil engineer, the principal of a high school in Chicago, the president of a missionary movement, a student of medicine, a fruit farmer, a man who has already gone ahead and bought a glass disc (he must have two, however), another man who strongly doubts whether the real, inside secrets will be revealed! (the secret is patience), a man who writes that our article in the November issue was "about the fifth he has read, all of them telling it was easy, but none how!" (It is not "easy")

Thus we present a small, random cross-section of the group that wishes to make telescopes Out of all these beginners it may be confidently anticipated that a number of experts will gradually develop, and that, perhaps, a few positive geniuses at glass working may be discovered—men who do not even know at present that they are potential geniuses in this careful work In this connection, Ellison explains in his book, "The Amateur's Telescope," that most of the really great makers of the *large* mirrors began as rank amateurs and, almost self schooled, beat the existing professionals at their own work

Late in November, 1925, the writer had occasion to spend a week-end with Mr Russell W. Porter in his Vermont home, and on that occasion the letters from our enthusiastic would-be telescope makers were taken along On one day we met with *The Telescope Makers of Springfield, Vermont*, at Stellar Fane, described in the November Scientific American

Arriving on the mountain-top in the afternoon, we found a dozen of the members already there, having a wood-cutting "bee" which resulted in the reduction of several logs to fireplace fuel for the astronomers' winter comfort Next came another kind of "bee," when fourteen men sat down to the laureate-cook's steaming repast Finally, when the table was cleared, the members of the group sat in a big ring around the fire place, busily engaged for an hour in reading the interesting letters received by the Scientific American from people who want to become amateur astronomers, like themselves These men of Vermont were literally delighted over the widespread and enthusiastic interest in telescope making which was proclaimed by the letters from our readers.

Later, a day was spent with Mr. Porter in his laboratory, filled with all kinds of optical apparatus, telescopes completed and partly completed, testing equipment, and silvering materials, while a peculiar "kink" in the writer's mirror succumbed to Mr. Porter's skilled assistance, it being successfully fought to a finish after an afternoon's effort

With Mr Porter's articles, and especially his excellent illustrations and photographs (accurate pictures of the true appearance of a correctly parabolized mirror under the Foucault test have previously been almost unobtainable by the average beginner), and the equally striking drawings of telescope mountings which he has prepared for the next issue of the Scientific American—these, coupled with the book by the Reverend Mr. Ellison (maker of more than 130 mirrors), a book which covers telescope making in more detail than it could have been conveniently done in the Scientific American, and which is as requisite as any of the other working materials for the proper prosecution of the work briefly outlined at our request by Mr Porter, make us sure that no such an opportunity to learn the art of mirror making has previously been presented to the amateur.

* * *

The World's Largest Passenger Locomotive

THE photograph of two locomotives of the Baltimore & Ohio Railroad, reproduced on this page, tells the story of the rapid growth of the locomotive in size and power during the present generation.

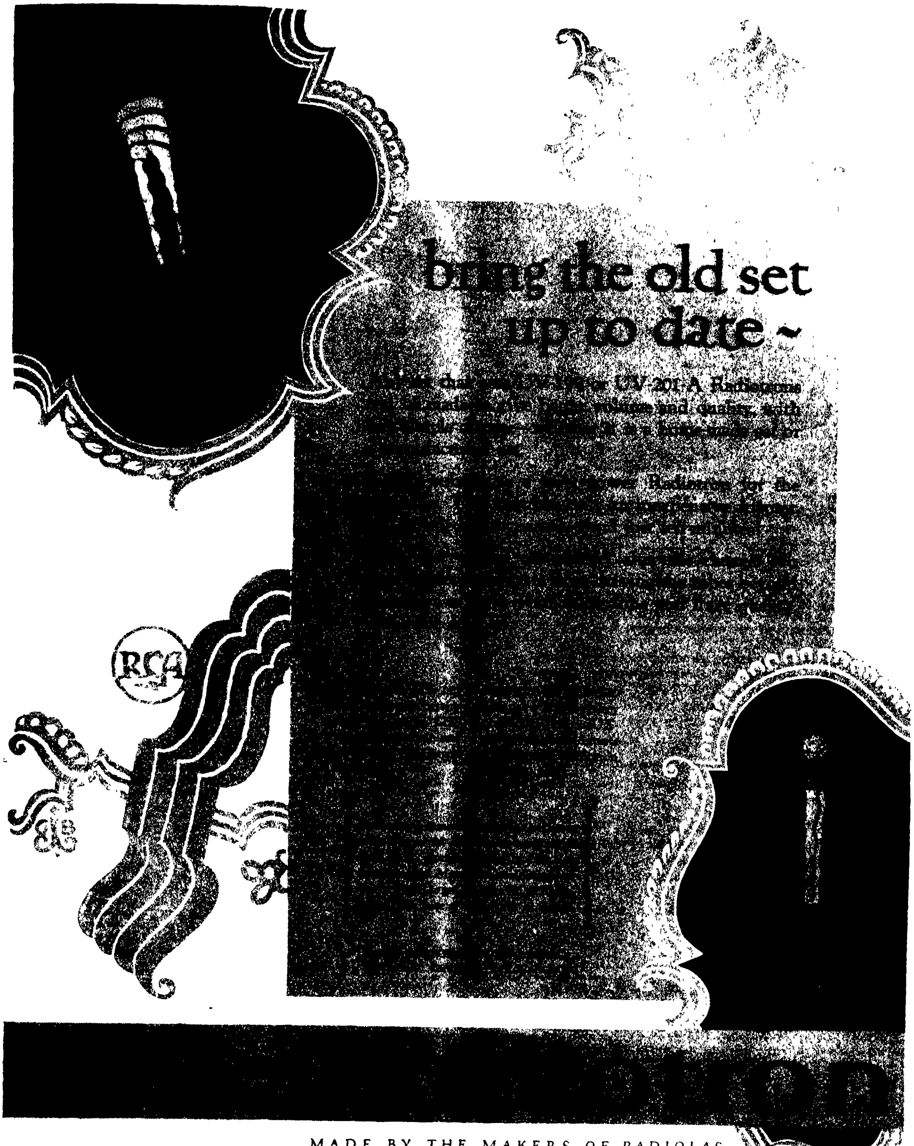
No 1400, the smaller of the two, is by no means an antique, It presents none of those earmarks of age such as elaborate moldings on the steam dome and sandbox, which were considered the beauty marks of an up-to-date locomotive of the last generation. It is a standard, eight-wheel passenger engine of the type which hauled the crack express trains of not so long ago, and was a powerful engine in its time, with 20-inch by 24-inch cylinders, 1,500 square feet of heating surface, a rated tractive power of 19,800 pounds, and a total weight of 111,000 pounds without the tender. Including the tender, the weight is 201,400 pounds. It was an excellent engine and did its work effectively, until the increase in size and weight of passenger trains began to overtax its strength, and it became necessary to build larger engines to handle the larger trains

It would take a book to describe the gradual growth of the locomotives of the Baltimore & Ohio Railroad from No 1400 to the truly mammoth engine 5500 which is shown for comparison in the photograph, so we must be content to note the lines along which that growth has proceeded Compared with European practice, American engineers have made it a point—the first point, in fact—to provide their locomotives with boilers of large capacity, and so to proportion the cylinders that the engine would be sure, at all times, of an abundant steam supply Hence, we find that, whereas No 1400 has a boiler whose greatest diameter is 62 inches, carries a steam pressure about 180 pounds, and has total heating surface of 1,500 square feet, the diameter of the boiler of No 5500 is 100 inches, the steam pressure is 220 pounds and the total heating surface is 6,896 square feet. The cylinders have increased from 20 inches by 24 inches, to 30 inches by 30 inches; the weight of the engine alone from 111,000 pounds to 400,000, and the tractive power from 19,800 pounds to 65,000 pounds

There follows a comparative table of the dimensions of the two locomotives:

	Locomotive of 1890	*Number 5500*
Cylinders	20" x 24"	30" x 30"
Valves	Slide	Piston
Clearance height	14' 5½"	15' 5¾"
Clearance width	9' 10"	10' 8"
Length	58' 8"	100' 6"
Driving journals	8" x 8½"	11" x 13"
Boiler diameter	62"	100"
Tubes, No and diam	194—2¼"	269—2¼"
Tubes, length	11' 6½"	23'
Heating surface, total	1,500 sq. ft.	6,896 sq. ft.
Tender, coal capacity	8 tons	18 tons
Rated tractive power	19,800 lbs	65,000 lbs.

This powerful engine can haul twelve passenger cars over the steep mountain grades of the Baltimore & Ohio system, thereby rendering the use of pusher or helper engines unnecessary.



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[illegible] UV-201-A Radiotrons [illegible] volume and quality, with [illegible]

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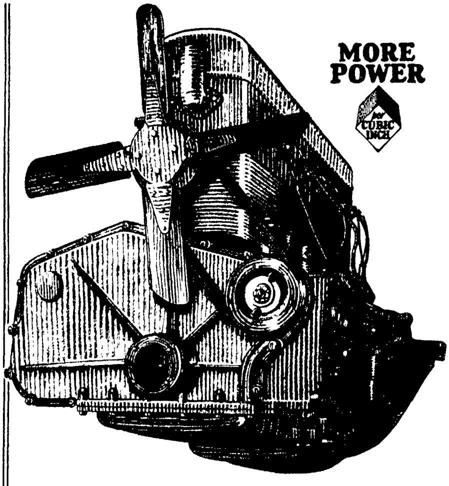

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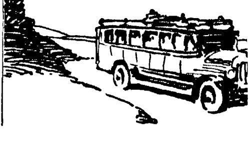


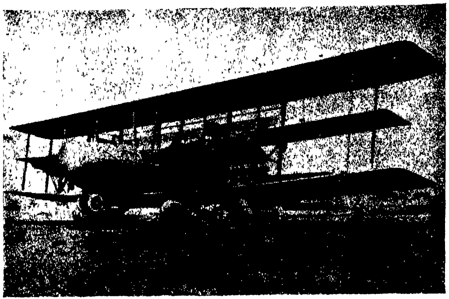
Wisconsin motors are built in a complete line of Sixes and Fours with power range from 20 to 105 H P

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics



International News Reel

The Barling Bomber, the world's largest airplane, which required two and a half years to build, is to be relegated to the museum at McCook Field

Farewell to the Barling Bomber

IN the photograph is seen the *Barling Bomber* which cost the Army Air Service $400,000 and took two and a half years to build. It was the world's largest airplane.

Some technical data will be obtained when Lieutenant Macready makes a number of flight tests in this giant of the air, but beyond this technical data this monster airplane has contributed nothing to the advancement of the world's aviation. It will soon be relegated to the museum at McCook Field, Dayton, Ohio.

A Novel Sport Plane

IN the previous issue of the Scientific American, we predicted that the use of aerodynamically lifting struts in externally braced monoplanes would become more frequent than it has been in the past.

The *Wright-Bellanca*, by the use of lifting struts certainly achieved remarkable results. Now the idea has been carried somewhat further in the Italian *Vittoria 1924* Sesquiplane, a novel type of sport plane of which two sketches are shown. In the first position, the struts provide all the necessary bracing for the monoplane wing, and at the same time, being cambered like the wing section, give lift themselves. In the second sketch, the struts are shown turned about a hinge. They now offer a large resistance to the air and can be used on the ground as a powerful brake.

The *Vittoria 1924* Sesquiplane, equipped with a 50 horsepower Anzani engine, has given a performance of well over 80 miles an hour. This new type of wing strut is certainly worth consideration.

Six Years of Air Transport

MAJOR GENERAL SIR SEFTON BRANCKER, as Director General of Civil Aviation, has had a unique opportunity for the first-hand study of commercial air transport. His paper before the Royal Aeronautical Society, summarizing six years of such experience, is therefore particularly valuable.

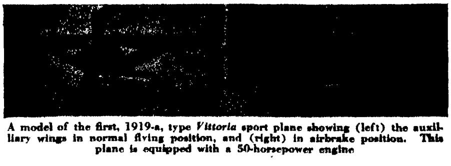
General Brancker is not only an administrator but a skilled pilot with practical knowledge of every phase of aviation. His paper reviews air transport and sets off those things which are vitally necessary to its success.

The majority of accidents on the London Paris route are associated with power plant failure. The General demands the provision of an infallible power plant even at the cost of extra weight and extra expense. Two and three engined ships may be helpful in securing power plant safety if it is found impossible to prove the reliability of a single engined power plant. The pilot is too often blamed for accidents which are quite beyond his control, and at the same time his comfort is not studied as much as it should be. The pilot should be provided with a comfortable and well screened seat, a really good view ahead and all around, a slow landing, and in the big multi engined machine, the provision for an assistant.

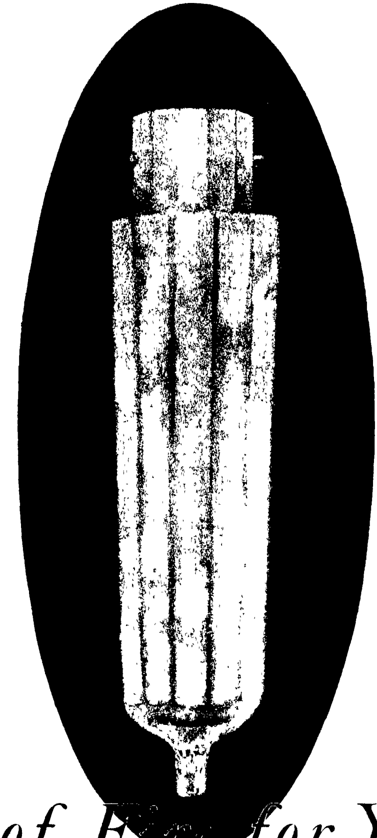
The sickness of a pilot in the air is very rare, but at the same time the provision of an assistant, who is capable of taking over all control when the pilot fails, is worthy of serious consideration.

At the moment that this is being written, news comes from London of a terrible fog covering the whole of England. Bad visibility seems to be the bugaboo of British aviation. With existing wireless equipment, it is possible to bring an aircraft easily over an airdrome in bad visibility. The British are experimenting with a view to being able to bring the airplane down even in the worst fog. The leader cable is used with satisfactory results, this being a cable made along

(*Continued on page 122*)



A model of the first, 1919-a, type *Vittoria* sport plane showing (left) the auxiliary wings in normal flying position, and (right) in airbrake position. This plane is equipped with a 50-horsepower engine



A STEEL INGOT

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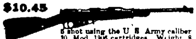

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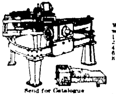

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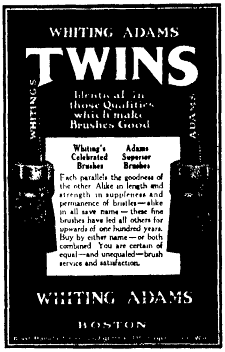

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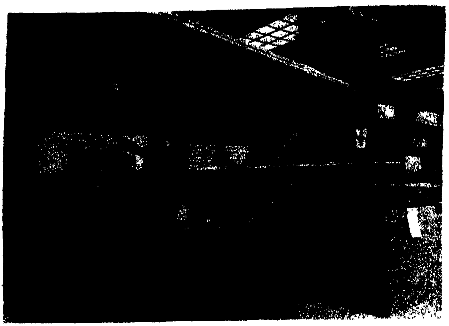

Figure 1: The Dornier *Dragonfly*, a small, two-seater flying boat, with the passenger and pilot seats *behind the motor*

the ground and carrying a current by which an aircraft may be guided by its pilot This together with a line of Neon lights—electric bulbs filled with Neon gas—will show the pilot where to flatten out as he glides in accordance with the leader cable indications

The General emphasizes very strongly the need of slow landing speeds These may be secured either by an increase in wing area or by such devices as flaps slots, etc It would appear that flaps and slots show great advantages and must be experimented with at all costs

Metal construction is also demanded by the General as likely to give far more endurance and reliability than wood construction

A German Aircraft Show

THROUGH the courtesy of the Editor of *Flugsport*, we are privileged to publish some interesting photographs of the very latest type of German airplanes and sea planes, exhibited at the Munich exposition of 1925 The Dornier *Libelle* or *Dragonfly* is built completely of the alloy duralumin with a 70 horsepower, seven cylinder air-cooled motor It can carry a pilot and a passenger with full load of gas at a speed of 90 miles per hour The *Libelle*, contrary to usual practice, is a "tractor" flying boat, with the engine ahead of the occupants who are thereby freed from the danger in a crash of the engine piling on top of pilot and passenger The Dornier *Comet* is a six-passenger transport airplane used extensively on the lines of the German Aero Lloyd, with a comfortable and attractive looking cabin (Figure 3, page 124) One of our illustrations gives a general view of the exposition, showing in particular the small, low powered "baby" planes for which German industry has gained such a reputation.

Not the least interesting exhibit at Munich is that of the Heinicke parachute Unlike our own military pilots, who generally sit on a carefully folded chute, German aviators carry their parachutes on their backs The illustration on page 126 shows how the pilot makes his exit Sometimes the pilot's jump is much more hurried than the leisurely demonstration on the ground indicated in our picture As the man clears the plane, the line still connected to the fuselage pulls the parachute out of its pack This snaps quickly and the parachute gradually unfolds, bringing the aviator down to safety

Four Liberty Motors on One Propeller

THE Handley Page *Hampstead* (shown on page 126), with its three engines, provides security against the failure of any one of them, but the plane as a whole is scarcely efficient because of the resistance of three large bodies breasting the air, namely, the central fuselage and the two outboard engine nacelles An aerodynamically more efficient solution is the placing of the multiple engines together in the fuselage, geared to one propeller, with a mechanical system permitting the disengagement of a troublesome unit

The Allison Engineering Company of Indianapolis has built such a power installation for the Army Air Service It is described in *Aviation*. The transmission con-

(*Continued on page 124*)

Figure 2: The Dornier *Comet*, a six-passenger plane used extensively on the air lines of the German Aero-Lloyd

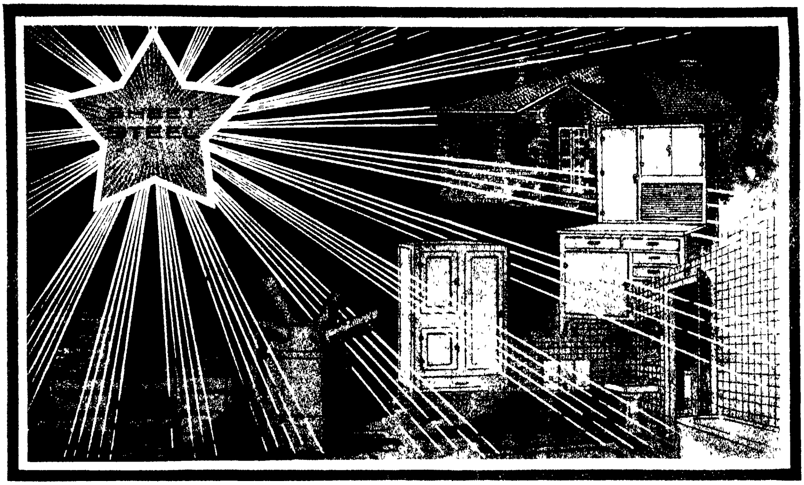

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Figure 3: The attractive passenger cabin of the Dornier *Comet*

sists of a large rectangular cast aluminum case, carrying four driving pinions, one in each corner, grouped round a large spur gear on the propeller shaft. Each pinion is driven by a 400 horsepower Liberty motor through a sliding tooth clutch in such a manner that any engine may be thrown in or out of gear at will. The reduction in speed is from the 1,700 revolutions of the Liberty to 577 revolutions of the propeller, which in large slow planes should rotate slowly to be efficient. The transmission complete weighs only 875 pounds, yet it has stood up successfully to a fifty hour endurance test. Every one has seen the mechanic with a piece of cotton waste in his hand, nursing the huge steam engines of an ocean liner. Now we shall have aero engine mechanic calmly working in an aerial engine room and making minor repairs on a temporarily disabled unit, while the huge plane continues to sail through the air at a hundred *miles an hour!*

Civil Aviation in Great Britain

AMERICAN commercial aviation neither receives nor seeks any form of direct government subsidy. But well informed opinion in the United States is unanimous in demanding that Congress provide for some form of air regulation and for support in the construction of airports and airways. The 1925 British report gives an illuminating picture of the help which the Director of Civil Aviation is able to render English *commercial flying along these lines.*

On the skill and fitness of the pilot depend the safety of airplane and passengers alike. The pilot should not be merely an aerial chauffeur, but must have a thorough knowledge of his plane and engine, be a skilled navigator, capable of guiding his craft through fog and darkness, and be fit mentally and physically to meet any emergency. The careful system of examination and licensing adopted by the British has produced a class of aviators who have a *training and a tradition comparable to the* best officers of the merchant marine. The British Air Ministry has even established a system of periodical medical examinations which ensures that the pilot is at all times perfectly fit, and inspires the greatest confidence in the traveling public.

We are fortunate in the United States in having a far better "flying" climate than the British Isles and their surrounding waters. But even in the United States, fog is a great enemy of the pilot, and the 500,000,000 candlepower *beacons of the Air Mail* route across the continent fail to pierce fog. It is very encouraging to learn therefore, that a new form of beacon, tested at the Croydon airdrome in London is likely to solve the problem. This new light consists of a number of glass tubes filled with Neon gas which is made incandescent by passing through it a high-intensity electric current. The resultant rich glow enables aircraft to locate the airdrome under conditions of the worst visibility.

Had the *Shenandoah* on its last flight been supported by an adequate meteorological service, the disaster would certainly have been avoided. In Great Britain all the

Figure 4: A general view of the Münich exposition, showing many of the well-known, German, low-powered planes

How a German parachute jumper makes his exit from a plane

meteorological services of the nation are under the control of the Director of Civil Aviation and pilots on the lines from London to the continent receive instant warning by wireless of any dangerous weather ahead

The work of the Air Ministry is not restricted to these auxiliary services, however valuable. Equal encouragement is given to the improvement of the airplane itself for passenger carrying purposes It is not always possible for the American manufacturer, although he does not lack the necessary skill, to make the large investment necessary for a giant airliner The Air Ministry places orders with private constructors for experimental machines of this type and then puts them at the disposal of the subsidized Imperial Airways for extended test The system is productive of much progress.

Even on a flight of a few hours, it is an ordeal to sit in a stuffy cabin if half the passengers are suffering the pangs of air sickness Accordingly, the British are experimenting with ventilating systems, with large scoops outside the fuselage not unlike the ventilators of a sea-going vessel, and reducing the discomforts of travel greatly thereby

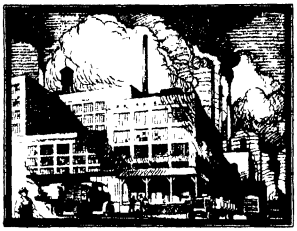
The airplane has now reached a point where its structure is perfectly satisfactory But power plant failure still remains to be cqnquered

Government support is enabling the British to build huge passenger carrying planes with three engines, capable of flying on any two of the three An example of this type of plane is shown in our photograph of the Handley Page *Hampstead* which is equipped with three air-cooled "Jaguar" engines of 385 horsepower each The *Hampstead* provides accommodation for 14 passengers in a Pullman saloon and has a top speed of 116 miles per hour Not only can this plane fly horizontally on any two of its engines, but it can actually climb 220 feet a minute with one motor completely dead Such a multi-unit power plant secures a safety which more than compensates for the smaller efficiency of a three-engined plane as compared with a single-engined one

Still another significant tendency in British air work is the discarding of the water cooled engine with its burdensome weight of water and radiator, in favor of the simpler and lighter air-cooled power plant

A Delightful Sport

PERHAPS the value of gliding as a means of obtaining scientific data has been overrated. But it remains a delightful sport. It has not taken deep root in the United States, however; perhaps because the American young man demands the thrill of a powerful internal combustion engine, or perhaps because no such favorable meteorological conditions as exist in certain parts of Germany have been located on this side of the Atlantic. At any rate, gliding is an uncommon sight for most of us. Our readers may therefore be interested in a series of photographs received from Germany.



How one of the Lumber Companies got to know so much about the Factory Owner and his Lumber Problems

THREE or four years ago, a district lumber salesman happened to see a crate being made in the shipping room of one of his customers.

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Too many boards, too much weight. Not enough strength, nor enough protection for the merchandise.

It set him to thinking—and from that thought has grown the Weyerhaeuser Specialist Service that is one of the era marks in the use of lumber in American industry.

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THIS may sound like indifference on the part of the lumberman.

What it really means is that a lumber concern like Weyerhaeuser has a husky job of its own. A job that had absorbed all its energy heretofore.

It requires great timber resources and lumber manufacturing plants to feed into American industry the lumber it requires.

But from this point out Weyerhaeuser set itself to study lumber *users* and lumber *uses*.

This led them deep into many a specialized problem that the Factory Purchasing Agent and his employer had been struggling with patiently—but could not solve completely without the knowledge that only an expert lumberman could give them.

IT IS the function of the Weyerhaeuser Specialist Service to contribute this expert lumber knowledge to the industrial men of this country.

It is always a *specialist* contribution. A definite solution for the personal problems and needs of the *individual lumber user*.

Weyerhaeuser experts go almost everywhere. Not to sell a man something so much as to *tell* him what he wants to know about lumber in relation to his individual *use* of lumber.

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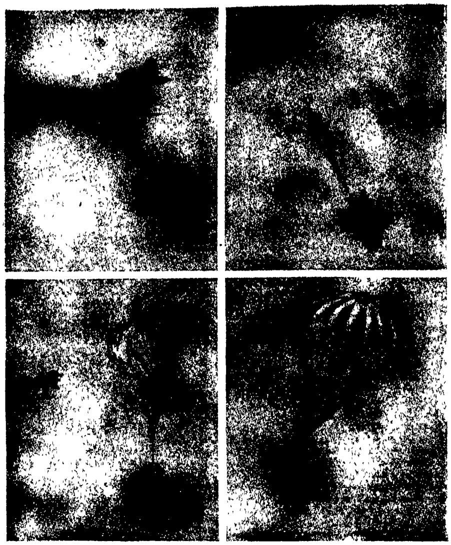

A graphic illustration of the way in which the German aviator leaps from his plane. The line connected to the fuselage pulls out the parachute from the pack, snaps and allows the parachute to unfold. Once open, the parachute fills with air and brings the aviator floating down to the ground in safety

For the start the glider pilot must have speed, and he has no power on board his craft to secure this speed One of our photographs (on page 127) shows him utilizing a motorcycle to pull the glider along the ground until the necessary speed is secured When sufficient speed has been obtained the pilot pulls a lever and releases the hook, clearly visible in Figure 2 He is dependent henceforth on his own resources. It will be noted that the pilot is strapped to his seat and that in this particular glider he maintains the equilibrium of his craft with only one hand clutching the control or "joy stick," the other hand grasping firmly the strut immediately in front of his seat

A convenient motorcycle is not always available, and in Figure 3 the group of husky young men have evidently been pulling hard on the towing rope now slackening in their hand after release by the pilot Incidentally Figures 2 and 3 illustrate the simple construction of a typical glider The pilot's seat is placed in the open on top of a skid A simple system of two booms and diagonals supports the tail surfaces, with a few wires for additional bracing

When the glider is once aloft nothing can equal the sensation of ease and mastery which is experienced by the pilot of one of these gliders

Why glide on a hillside, it may be asked, since the motorcycle or husky young men are utilized for the initial impulse? Because on the side of a hill may be found that upward circulation of air rising to the crest of the hill, without which the glider, no matter how skilfully maneuvered, must soon come to earth But given the right location and a favorable steady up wind, the glider can stay up indefinitely

The Automobile Airplane

AN airplane that could return on its own power from the flying field to a garage in the city is a plausible and fascinating idea The ordinary plane might conceivably undertake such a trip, but the spread of wings would be uncomfortable in traffic to say the least, the tail skid would not improve the roads, and the powerful airplane engine would not be suited for slow driving through crowded streets

Our Paris correspondent sends us a description of an interesting combination of automobile airplane designed by M. Rene

Wide World

The huge Handley Page *Hampstead* with three air-cooled engines. With a full load of fourteen passengers and fuel for several hours' flight, this giant of the air can fly indefinitely on any two of its three power units. This gives a great measure of security against motor failure in the air

Kadel & Herbert

Figure 1: Using a motorcycle to tow a glider up to speed for the start

Tampier, which seems to overcome these difficulties At any rate M Tampier has driven this strange vehicle through the streets of Paris and then flown from one of the big flying fields, without any trouble other than about thirty minutes' work in readjusting the landing gear and setting the wings in flying position.

The auxiliary motor aside from running the land running gear, can be used as a starter or as a prime mover for the lighting motor in the air, so that it is not useless even in the air

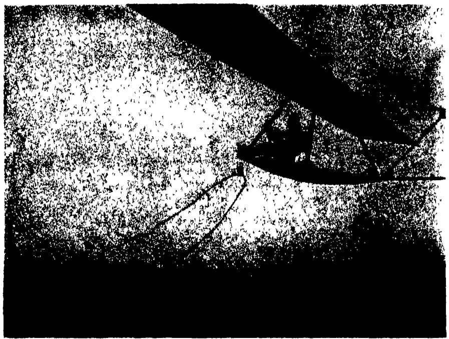

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Figure 2· Flying speed obtained, the pilot releases his towing rope by a lever

In this combination type of craft an auxiliary motor is set just behind the main flying motor The auxiliary motor is connected by a perpendicular shaft (as shown at the top of page 128) through a bevel gear drive to the axle of the main landing gear. On landing, the wings are folded back parallel to the fuselage by unfastening a pin or two, an extra set of wheels is attached to the rear part of the fuselage and the plane becomes a convenient motor car

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Figure 3: Sometimes husky young men replace the motorcycle. The towing rope is slackening in their hands after release by the pilot

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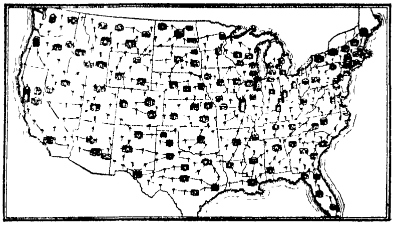

The Future of the Telephone

It was fifty years ago that Alexander Graham Bell invented the telephone, and yet this anniversary is but a milestone in the progress of telephone development. As the giant oak with its complicated structure grows from the acorn, so a nation-wide system has grown out of Bell's single telephone instrument.

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There are still to come many other discoveries and achievements, not only in transmission of speech, but also in the material and construction details of every part of the network of plant.

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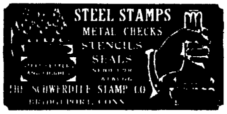

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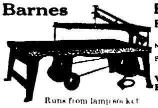

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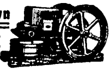

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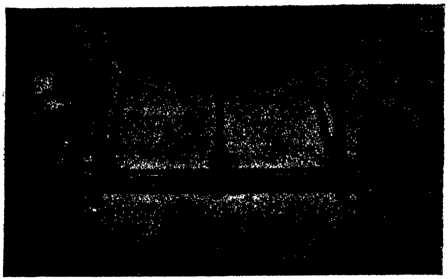


F M Delano

The driving mechanism of the Tampier automobile-airplane. A shaft runs perpendicularly from an auxiliary motor placed in back of the main flying motor. This shaft drives the axle on the ground through a bevel gear

F M Delano

The Tampier automobile-airplane with its wings folded back, and an extra set of wheels attached to the rear part of the fuselage. In this position it is ready to negotiate city traffic. It is a matter of about thirty minutes' work to readjust the landing gear and set the wings in flying position

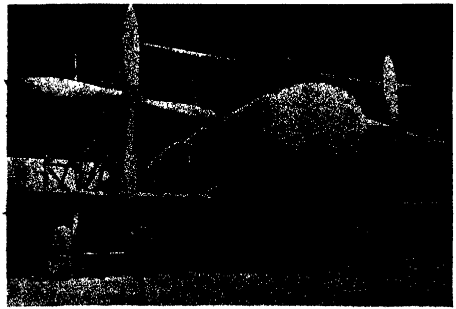
American Engines Are Conceded to Be Supreme

WHILE America may lag in the construction of large passenger carrying planes, there is no doubt that in the aero engine field, it surpasses all foreign practice. An English plane manufacturer is actually buying large quantities of Curtiss D 12 engines

These engines helped to win the Schneider Cup for the United States in 1923 and to secure the great speeds of the Pulitzer racers in 1923 and 1924

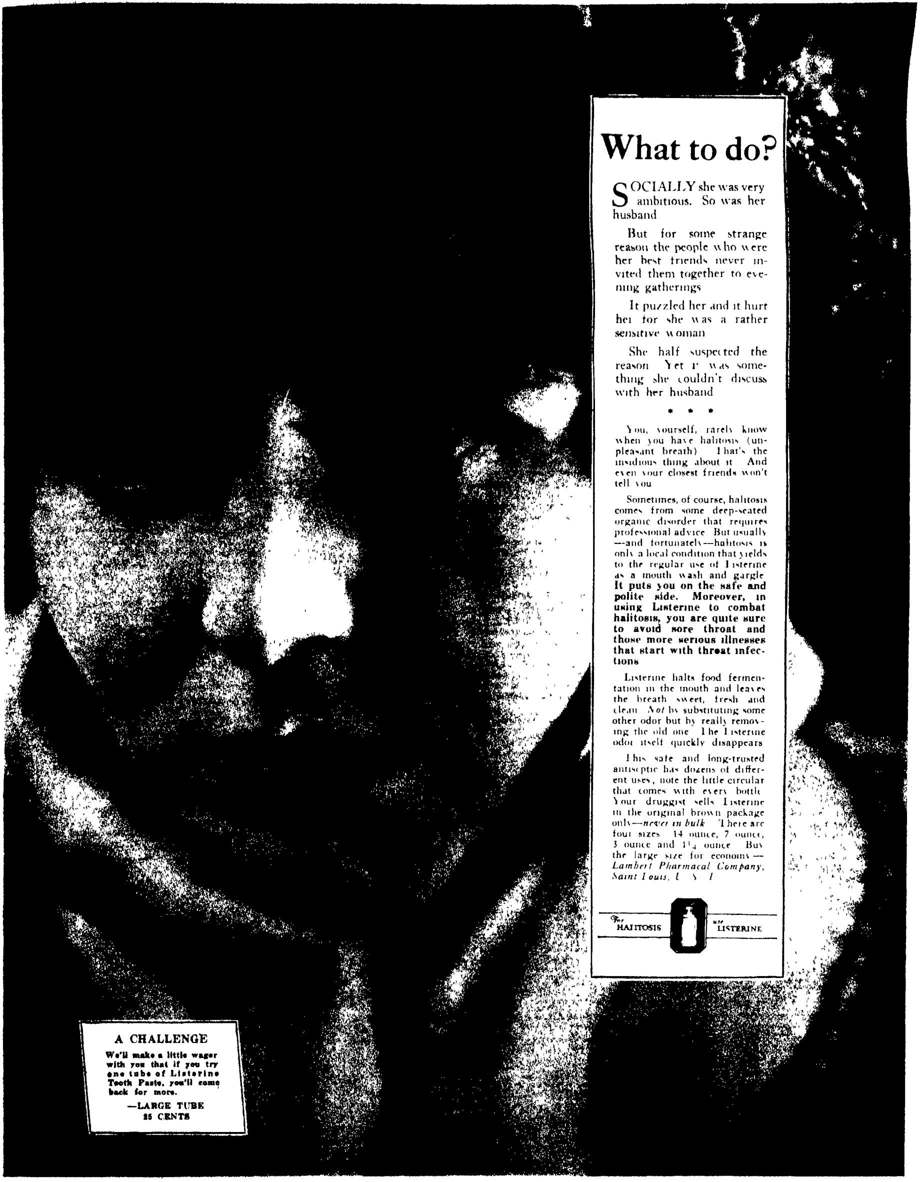
The Vickers Two-Engined "Vanguard"

SOME designers and pilots claim that even a two-engined plane gives a measure of safety against engine failure At any rate, British constructors are building very large two-engined passenger planes The Vickers *Vanguard,* equipped with two powerful Rolls Royce motors is an interesting example It can carry twenty-two passengers in comfort; there are even arrangements for serving meals during flight, a small table being fitted in front of each seat



Wide World

The Vickers *Vanguard*, equipped with two Rolls-Royce engines, one of the largest passenger planes in the world. It is capable of seating twenty-six passengers, with small tables fitted in front of each seat. Note the fine, rounded lines of the fuselage. Four-bladed propellers are used, because with a two-bladed propeller the diameter would become cumbersomely large



What to do?

SOCIALLY she was very ambitious. So was her husband.

But for some strange reason the people who were her best friends never invited them together to evening gatherings.

It puzzled her and it hurt her for she was a rather sensitive woman.

She half suspected the reason. Yet it was something she couldn't discuss with her husband.

* * *

You, yourself, rarely know when you have halitosis (unpleasant breath). That's the insidious thing about it. And even your closest friends won't tell you.

Sometimes, of course, halitosis comes from some deep-seated organic disorder that requires professional advice. But usually—and fortunately—halitosis is only a local condition that yields to the regular use of Listerine as a mouth wash and gargle. **It puts you on the safe and polite side. Moreover, in using Listerine to combat halitosis, you are quite sure to avoid sore throat and those more serious illnesses that start with throat infections.**

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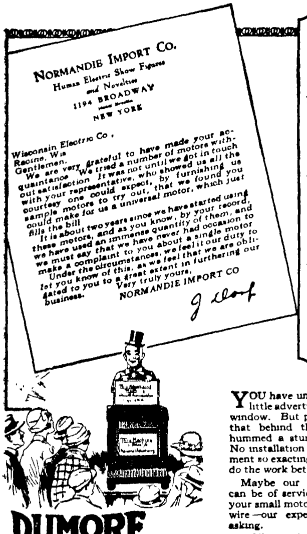

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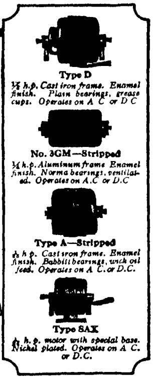

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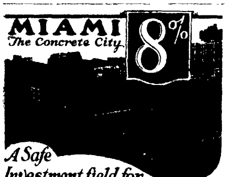

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Science and Money

Real Estate Mortgages

By Henry C. Trundle

TAKING the country as a whole, 42 percent of the homes occupied by owners are mortgaged, says W J Moore, president of one of the large bond and mortgage companies The percentage averages 56 percent in New York and adjacent States, which, incidentally, are among the richest in the Union. Instead of indicating a lack of prosperity or extravagance on the part of our home owners, this mortgaging of property means that our best citizens are utilizing the resources at hand to give them more working capital.

Mortgages Are Popular

A Brooklyn appraiser relates that over a period of five years in inspecting properties for loans he has come upon but one home which was unmortgaged This property was at the time unencumbered because the mortgage had just been paid off as a wedding present, the young couple was quick to remortgage it

Very few of the homes in a large city and an even less number of large office buildings, hotels and corporate undertakings are without a mortgage upon them Were it not for this privilege many persons of moderate means would be tenants and huge structures would never be erected because of the inability of interested individuals to finance them.

Real estate mortgages are known to have been made by the Babylonians as early as four thousand years ago Probably before and certainly since then, and in every country, land and the buildings upon it have been accepted as security for an indebtedness The excellent security of land is evident for it is a fixed and tangible article Man requires soil to till and live upon and besides actual sustenance his chief want is for shelter Land and buildings are, therefore, always in demand wherever there is habitation

Safety Is the First Principle

Safety of principal and interest, the first consideration of every investor, has become recognized as the accepted feature of investments secured by real estate mortgages issued under proper conditions Investment offerings having behind them the credit of nations, world known industrials or transcontinental railroad systems, have at times had their values seriously impaired, with subsequent loss to the purchasers, but real estate mortgage concerns boast (sometimes unduly) of their records of years without loss to their customers Such mortgages are, and have always been, popular with investors of every size and the reasons are not hard to find

The subject of real estate mortgages falls naturally into two divisions (a) as affecting the borrower (b) as affecting the lender or investor.

Borrowers who pledge their real property as security for a loan are chiefly (1) home builders, farmers and small buyers who want eventually to own their own property and who need credit on convenient terms, (2) builders who need capital for the large building operations, (3) operators and investors who find it profitable to use other people's money in addition to their own, so as to obtain a larger return on their own capital, (4) promoters or developers who undertake to convert large waste areas into productive enterprises and (5) corporations who construct and operate large properties such as office buildings, terminals, warehouses, hotels, amusement centers and similar propositions beyond the scope of individual enterprise.

Why should a person mortgage his property to obtain money to reinvest? Why go into debt and have the trouble of collecting monies due him and of paying monies due another? Would it not be more convenient and just as profitable to live on one's property free of debt? These are questions which are frequently asked, and their answers are simple.

First, there is the individual who borrows on his property at 6 percent because he can obtain 8, 10, 15 percent or more upon the money thus received by investing it in his business or in a venture of some sort. Secondly, there may be a vacant lot or small building, the income from which is insufficient to pay taxes or provide a net profit. Additional capital invested in the project may enable it to be fully productive. Real estate buyers have often had their investment in non productive or unimproved land wiped out entirely through taxes, without mentioning loss of interest, before appreciation in value was sufficient for a profitable sale. Improvements in the nature of buildings or otherwise may turn an unfortunate investment into a decidedly profitable one Hence, one borrows.

How Is a Loan Arranged?

Having found it necessary to borrow or having decided to do so, how is a loan arranged? Size, perhaps, dictates the method Familiar, of course, is the small town banker who knows intimately both property and borrower The services of an acceptable lawyer complete the deal In the large communities will be found mortgage companies which maintain appraisal, legal and selling experts Building and loan associations, organized under state laws, provide a convenient means to borrow Large loans, usually upon well known properties, are obtained from investment bankers and in turn sold by them in the same way as corporation or government securities

Farmers who at times have found it difficult to borrow upon their property are now aided through the Federal Farm Loan Act which provides capital for agricultural development, creates standard forms of investment based upon farm mortgages, and equalizes rates of interest upon farm loans Such loans are secured by first mortgages, must be paid off within from 5 to 40 years, must be used to extinguish pre-existing indebtedness or for productive purposes, and the rate of interest cannot exceed 6 percent per annum This act has contributed largely to the current prosperity of our western farmers who had found their credit entirely "frozen."

Mortgages Are Sound Investments

Insurance companies are known to be large purchasers of real estate mortgages, for every dealer in them emphasizes the fact that conservative insurance companies have taken a sizeable block of the loan under consideration, or at least that they are buyers of mortgages of a like character. Perhaps it is not so generally known that insurance companies themselves make many loans secured by mortgages.

Having considered the mortgage business from the standpoint of a borrower, let us view it as a lender upon or an investor in mortgages Quite naturally there have come to be innumerable concerns and individuals whose business it is to loan upon mortgages and in turn to offer them as possible investments to others who have surplus funds seeking safe and profitable employment When the amount of a proposed loan is beyond the individual capacity to lend, it is inevitable that the loan must be obtained from professional underwriters. It is these companies that will next be discussed.

In many cities there are mortgage companies and title companies which offer guaranteed mortgages. Some loan on improved property only, while others loan on both improved and unimproved property. These mortgages usually run for three years, and at maturity the investor can ask for payment of the loan, although the majority are extended. As these loans are offered for sale to the public with payment of principal and interest fully guaranteed, the rate of interest to the investor is usually one half of 1 percent less than the rate named in the mortgage, this difference of one-half of 1 percent being the premium charged by the company for its guarantee The company pays the interest when due, whether it has collected it or not The principal is paid at maturity if desired; but in order to protect itself against the necessity of paying guarantees at a period of financial stress, some provision is made to withhold payment for a certain number of months, so that there will be sufficient time to collect from the owner of the property.

Some mortgage companies for the payment of the small fee of one-half of 1 percent will take over a mortgage held by a private individual and guarantee payment of principal and interest The company collects the interest, sees that taxes, assessments and insurance are promptly paid, and safeguards the security itself by periodic inspection of the property, thus relieving the investor of such responsibilities For so small a sum the investor can obtain the full co-operation of experts in mortgage lending in the supervision of his own loan

As an outgrowth of the title guarantee business, associated companies have been formed to deal in mortgages One such organization has had sales amounting to over one billion dollars in the more than forty years of its existence. Not only has this company provided an investment in convenient amounts for its customers, but it has aided as well the small borrower. It has been the general policy to lend upon homes and small land holdings and during its life the company has guaranteed more than 120,000 mortgages.

Underlying Guarantees Are Important

The question of the adequacy of a company's assets to meet the liability of the mortgages it guarantees is one that is constantly raised. It is often forgotten that such companies are in effect insurance companies and that their insurance business is conducted at proper rates. Other types of insurance and casualty companies are continually paying losses; these losses are understood to be a normal part of their business. Real estate mortgage losses are so infrequent—said by one guarantee company to be less than one-tenth of 1 percent of its guarantees—that it can be seen that this type of underwriting is a safe proposition for the company, and likewise that it provides a sufficient element of strength for the investor

Purchasers of guaranteed mortgages therefore, have behind their investment, the property securing the loan, the assets of the guaranteeing company and also the personal bond of the borrower.

Another type of real estate mortgage dealer is one which concerns itself only with propositions running into hundreds of thousands and millions of dollars Loans may be made upon fully constructed and tenanted properties or for construction purposes The former loans are not so intricate and are generally easily marketed Building loans require a great deal of expert opinion, and it is a testimony to the integrity and careful judgment of our great mortgage houses that they have been consistently successful in their business The great real estate developments have been made possible through their courage in undertaking them and the public's confidence in financing them.

The interests of the investor in the bonds issued by a company offering this type of business are safeguarded by these principles

(1) Each bond issue must be a first mortgage on improved, income-producing real estate of the best class
(2) The property must be well located and thoroughly suited to the rental demand of its neighborhood.
(3) Income must be sufficient to pay interest and to amortize the principal.

It should be noted that payment of principal and interest is not guaranteed, although the advertising slogan of one company is that for over two score years no investor has suffered a loss Before any bonds are sold a title insurance company has investigated the borrower's title to the property, and if everything is satisfactory, a guarantee company issues a policy covering the whole bond issue The object of this is to substitute a guaranty for an opinion in regard to the validity of titles to real estate. All the legal details are passed upon by skilled lawyers, and a competent trust company is usually appointed trustee to see that the provisions of the trust deed are properly complied with

Recognizing the unexcelled investment qualities inherent in real estate mortgage bonds, banking firms which previously had concerned themselves strictly with corporation or government securities, have now gone into this type of financing These bankers, however, ordinarily are interested only in the very large issues. The bonds are marketed in exactly the same manner as any corporate security, which means that they are distributed by the originating house, through all of its branches, and by other firms which are associated with it in a syndicate formed to dispose of the issue

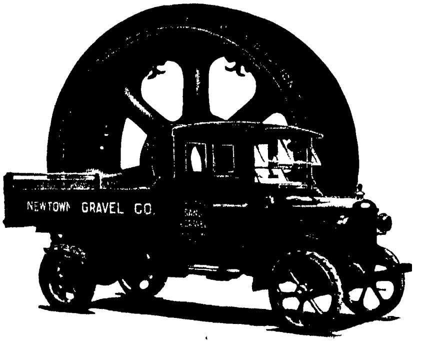
So far in this article we have had in mind only first mortgages Of course there are any number of varieties of mortgages junior in lien The price at which they are offered to investors is commensurate with the risk Such mortgages lean to the speculative and should be purchased only after careful consideration and with full knowledge of their risks.

The precise names of common forms of real estate mortgage offerings are mortgages participating mortgages and bonds A mortgage as a vehicle of public financing is suitable only in the case of relatively small loans. Where two or more persons desire to share in a loan, a mortgage is made to a trustee who will issue a certificate of ownership to each person having an interest in it The major part of real estate financing is done by means of bonds issued against the actual mortgages which are held by the lender or deposited with a trustee. Still another form is the collateral trust real estate bond, which is the obligation of the mortgage company secured by deposit with the trustee of mortgages of various amounts If the company is a sound one such bonds should be safe

Mutual Profit Mortgages Now Available

A new type of junior real estate security is offered by a company which sells the preferred stock of a corporation formed to own and operate a property, which is usually a well located office building that has been planned and built by the same interests in associated capacities A mortgage, amounting to about 50 percent, is placed upon the property and a loan secured elsewhere, the balance being obtained through the sale of stock Each share of preferred is accompanied by two shares of common, one of which goes to the purchaser of the preferred and the other to the security company It is the plan to pay preferred dividends and to retire the principal within a period of ten years Thereafter the investor shares equally with the security company in all net profits through the ownership of the common stock This type of security is gaining in popularity and undoubtedly is of especial interest to those who rent in such properties and who believe that huge profits accrue to the owners Its speculative nature should be remembered

If real estate first mortgages are so prime an investment, what is the explanation that they are offered at varying prices yielding from 5½ to 7 percent, more or less? It has been a custom of the business to sell mortgages and mortgage bonds at par or 100, the interest rate corresponding to the normal rate of interest This, at times, has worked a hardship upon mortgage dealers who have found it difficult to maintain their prices at 100, when other classes of security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have been offered at much lower prices due to economic conditions. Investment houses, as ordinarily understood, on the other hand, have considered that real estate mortgage bonds should be marketed on the same basis as any other security Prices for that reason have been subject to market fluctuations and vary from time to time Short term issues are high priced, while the longer maturities are moderately priced

The chief objection to real estate mortgage bonds has been that they are not readily marketable Many investors prefer to have their entire funds in securities that can be liquidated immediately and without loss Mortgage concerns attempt to meet this requirement by repurchasing bonds at a price only one or two points lower than the offering price When they believe the bonds are offered for repurchase so that another investment may be made, they make a nominal bid sufficiently low to discourage the sale

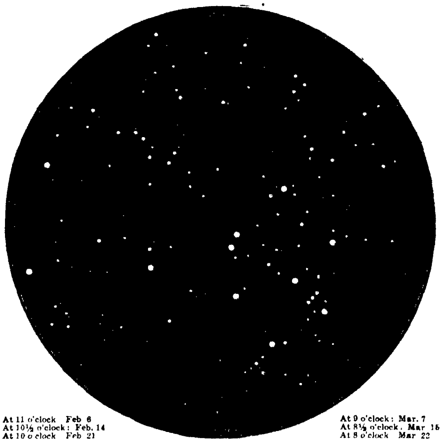
Guaranteed mortgages are likewise repurchased in necessary instances on a satisfactory basis Investment houses which maintain a market for their real estate bonds do so with the usual spread of 1 or 2 points It is interesting in discussing marketability to note that disinterested security dealers or brokers are trading more and more in the larger issues of certain real estate mortgage concerns and that an outside market is rapidly being built up.

Because the future success of real estate mortgage houses is dependent upon past records, each house considers itself under obligations to its customers until every dollar of principal and interest has been paid Some insure principal and interest through associate companies; others have the mortgages guaranteed by casualty companies doing a general insurance business. In all cases every precaution is taken that the monies invested in their offerings are safe and the interest and principal promptly paid

Just which is the strongest financing is anybody's guess; but it is evident that the investor in real estate mortgages would do well to give careful study to any proposed investments George E. Roberts, Vice-President of the National City Bank, and an authoritative writer upon economic conditions, says "the building boom is going too strong to last" This statement indicates that the wisest cours is to deal only with responsible houses.

The Heavens in February

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock Feb 6
At 10½ o'clock: Feb. 14
At 10 o clock Feb 21

At 9 o'clock: Mar. 7
At 8½ o'clock. Mar 15
At 8 o'clock Mar 22

At 9½ o'clock: March 1

NIGHT SKY: FEBRUARY AND MARCH

The Heavens

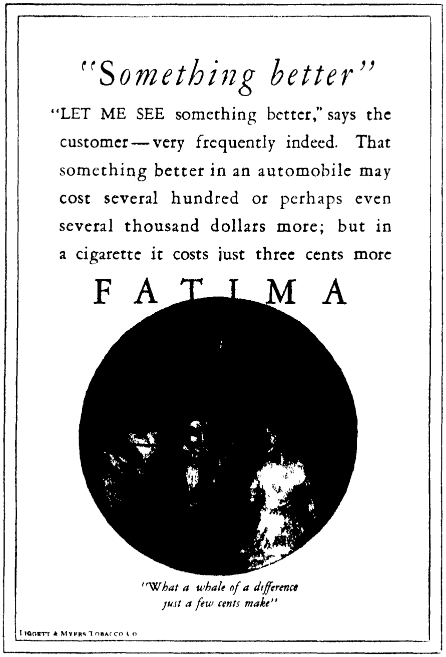
THE southwestern sky is now at its best Orion, the Great and Little Dogs, Taurus, and Gemini are all within this quarter of the sky, and Auriga is only just outside of it The northwest, with Perseus, Andromeda and Cassiopeia, is less brilliant Draco and Ursa Minor are low in the north and Ursa Major high in the northeast, with Bootes rising below Leo and Virgo are in the east, while Hydra is the most notable constellation in the dull southeast

The Planets

Mercury is in conjunction with the sun, and behind him, on the 15th, and is invisible all the month Venus is also in conjunction on the 7th, and in front of the sun. Before the end of February she comes out as a morning star, and on the 28th she rises before 5 A.M and is conspicuous. Mars is a morning star in Sagittarius and rises at 4:10 A.M in the middle of the month Jupiter is also a morning star, but much nearer the sun On the 17th, he is in conjunction with Venus, and both planets may be seen in the dawn—nearly ten degrees apart.

Saturn is in quadrature, west of the sun, on the 15th, rises at 1 A.M and is observable in the morning hours Uranus is in Pisces and sets about 8 P.M. Neptune is in opposition on the 12th—being then in Leo in 9 hours 43 minutes R A. and 14 degrees, 3 minutes north declination, but is visible only with a telescope.

The moon is in her last quarter at 6 P.M. on the 5th, new at noon on the 12th, in her first quarter at 8 A.M on the 19th, and full at noon on the 27th. She is nearest the earth on the 12th and farthest off on the 25th During the month she passes near Saturn on the 6th, Mars on the 9th, Jupiter on the 11th, Venus and Mercury on the 12th, Uranus on the 14th and Neptune on the 25th.



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Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Fotograms

This is the short-wave receiver used at Station 2CV. A description of this long-range amateur equipment is contained in these columns

Brooklyn Boys Talk with Australia

Two Brooklyn boys have built an amateur station recorded in the Government's call book as 2CV, in order that they might experiment with short waves and make friends with amateurs in other countries The operators, Irving Korenman and Frank D Manz have carried on two-way communication with three amateurs in Australia, two in New Zealand, others in Samoa, Hawaii, Chile, the Argentine, three countries in Europe and in forty-three States They also talked with the U S. destroyer *Scorpion*, anchored in Trieste Harbor, Italy

One morning, at 5·40 o'clock, one of the operators was tuning around the dials of the 39 meter Reinartz three-tube receiver when he picked up the signals of the U S S *Seattle* He started the transmitter and called the ship and communication was immediately established over the span of 2 200 miles, for the ship was 400 miles northwest of Balboa The Navy operator requested press and the amateur asked him to QRX -stand-by—until he ran out to the newsstand on the corner to get a morning newspaper Daylight was gaining in strength and aware of the light's effect on low waves the boy hurried When he reached his station he found the vessel still standing by on the 39 meter channel and he broadcast 1 500 words of the morning news

The waves were intercepted by the three tube set in connection with a small antenna *strung around the molding of the room* The wiring diagrams and photographs of the simple receiver and transmitter are published on this page They will undoubtedly be of interest to hundreds of radio experimenters The following specifications apply to the diagrams

The transmitting aerial is a single wire 35 feet long and the ground is a counterpoise, built as a duplicate of the aerial and underneath it, a few feet off the ground The receiving antenna is an indoor affair, consisting of a copper ribbon 20 feet long strung around the molding of the room The counterpoise or ground, used for receiving is 15 feet of wire laid *on the floor* below the antenna

The detector is a UV 201 A with the metal base removed to minimize capacity effects which would have a detrimental effect upon short waves Simplicity is the keynote of success in short-wave transmission and reception A standard two stage audio amplifier is used

In the receiver, diagram "A" is five turns of No 16 D C C (double cotton cover)

Fotograms

The transmitting equipment of Station 2CV. From Brooklyn, New York, the amateur operators of this station have talked with the U. S. Destroyer *Scorpion*, anchored in Trieste Harbor, Italy

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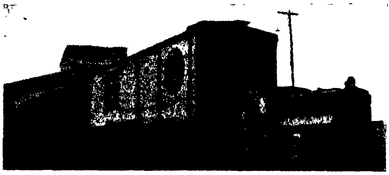

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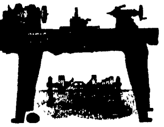

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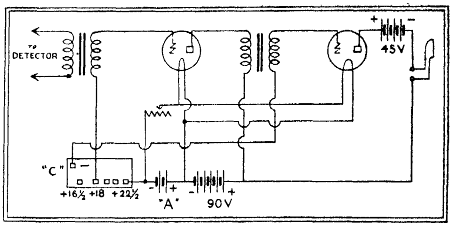


This diagram shows the audio amplifier circuit as wired for the new UX-120 power amplifier tube. If a UX-socket is used this diagram should be followed. The UX-tube will not fit the ordinary socket unless an adapter is employed. When the adapter is used no change in wiring is required in the average set, as connections for the extra 22½-volt "C" battery and 45-volt "B" battery are provided on the adapter

wire, wound as a self-supporting coil It is loosely coupled to the secondary Coil "BCD" is also self-supporting That is, it is not wound on a tube or permanent frame "BCD" is tapped as illustrated, "B" has four turns of No 16 D.C.C wire, "C," nine turns and "D," four turns of the same size wire V1 is a three-plate variable condenser, V2 is .000125 mfd capacity and it controls regeneration C1 is an .0002 mfd. grid condenser and 9 megohm grid leak I is a radio frequency choke coil of 150 turns of No 30 S C C (single cotton cover) wire, wound on a tube one inch in diameter

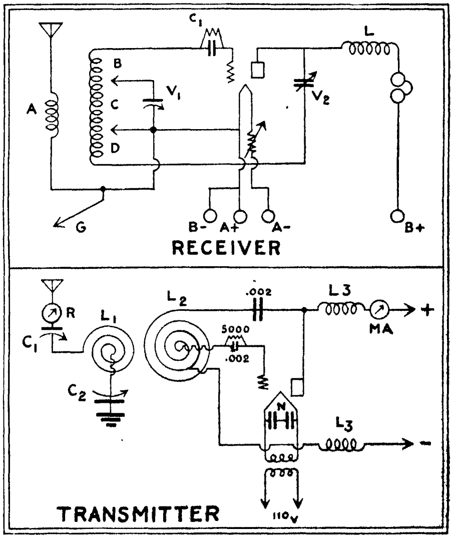
The transmitter is a loose coupled Hartley circuit The high voltage is derived from a step up transformer delivering 1,500 volts to an "S" tube rectifier system and a filter system consisting of a 30 henry choke coil and a 6 *mfd* filter condenser In the transmitter diagram, "R" is a radiation meter, L1 is a pancake coil of five turns of one half inch brass ribbon L2 is a pancake coil of nine turns of one-half inch brass ribbon C1 and C2 are variable condensers of .00025 mfd capacity. L3 is a radio frequency choke of 150 turns of No 26 D C C. wire wound on a glass tumbler "MA" is a milliammeter. "N" represents two fixed condensers each 1 mfd. capacity

Ten Million in Advertising

THE radio industry will invest $10,000,000 in advertising this season, according to the estimate of an investigator reported to the Bureau of Advertising of the American Newspaper Publishers' Association Of this sum, it is figured $2,500,000 will go to newspapers.

Listeners Report on Super-power

SINCE the first super-power tests made by WGY, Schenectady, using a 50-kilowatt transmitter, thousands of reports regarding reception have been received at the station. Not all of them are favorable but by taking averages, we have a fair impression of what listeners think of high powered waves Of all letters received, 81 percent reported that the signals were twice as loud; 64 percent



The wiring diagrams of low-wave station 2CV. This station, owned and operated by two Brooklyn boys, has talked with many foreign countries and with American ships abroad. The hook-ups are explained above

Courtesy of the National Council of the Y M C A

Professor C. H. Robertson, scientist and lecturer, who introduced the wireless telegraph in Manchuria. Professor Robertson is shown here demonstrating the apparatus to Governor C. C. Sen

reported that fading was reduced and more than 88 percent found super-power just as easy to tune out as the regular power, ranging from 500 to 5,000 watts Static and disturbances from electrical devices were less on the high power according to 70 percent of the reports. The southern and western auditors wrote that although 5,000 watts from WGY were inaudible, or weak, the super-power produced good signals

Short Waves Gain in Popularity

SHORT *wave broadcasting continues to gain* in popularity Station CJCM, Mont Joli, P Q, Canada, using the slogan "On Top of the World," has stopped broadcasting on 312 meters and is now working on waves below 50 meters.

Station WTIC, Hartford, Connecticut, has installed a low-wave equipment which is recognized in the air as IXG, an experimental call. This transmitter has been heard in Australia.

Airship's Elevation Measured By Radio

ELBERT N. TODD, of Crisfield, Maryland, has patented a method of ascertaining elevations of aircraft, the principal feature of which is the transmission of a radio wave at the surface of the earth, which may be consequently detected by receiving instruments carried by the airplane.

Radio Supervisor in Sub-Treasury Building

THE United States Radio Supervisor and his staff, assigned to the New York area, are now located on the third floor of the United States Sub Treasury Building, at Wall, Nassau and Pine Streets, having moved from Room 603 at the Customs House

How to Improve Tone Quality

THE tone quality of the Western Electric 540-W cone type loudspeaker in connection with some sets can be improved by a simple alteration which engineers term "loading" The first operation is to remove the thumb screw at the apex of the cone The second step is to remove the five screws nearest the centre, at the rear of the loudspeaker This allows the metal ring to be removed and leaves the inside mechanism open to view Then remove the three screws which hold the mechanism in position on the frame The next step is to remove the small screw which holds the driving armature to the support at the open end of the horseshoe magnet and place a small piece of friction tape between the two metal parts the screw holds together A small hole must be cut in the tape to permit the screw to pass through Then wind the piston of the driving mechanism with tape and stretch it tightly, but do not bend the rod The tape on the driving pin, which extends through the apex of the

Courtesy of the National Council of the Y M C A.

Li Yuan Hung, recent president of the Republic of China, is an enthusiastic patron of the popular scientific lectures. He is shown with his son and daughter and Professor Robertson. The apparatus in the picture was built for this lecture work and was mounted on panels so as to be accessible from front and rear, allowing every detail to be followed out. Two 5-watt tubes were used for transmitting, and for reception, a detector and two stages of A. F. amplification were used, three more stages being added when the loudspeaker was employed

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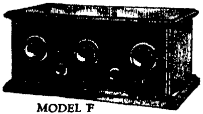

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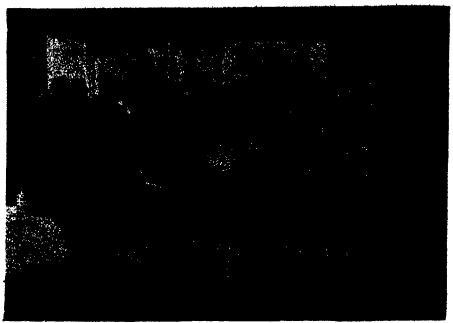

Courtesy of the National Councils of the Y M C A

Here is a typical Chinese audience, assembled to hear Professor Robertson's lectures. Such a group meets four times each day

cone, should be vulcanized by burning it with a match This prevents it from loosening The operation is now completed and the loudspeaker can be reassembled

KFKX Features Farm Service

ONE of the most complete market and weather report services in the middle west has been instituted by station KFKX Hastings, Nebraska The reports radiated five times daily are furnished over a special Government wire to the studio of KFKX, direct from the Federal Department of Agriculture Quotations from the principal primary live stock and commodity markets in the midwest territory are broadcast The reports are put on the air at 9 30 A M Central Standard Time, 10 30 A M 12 30 P M, 3 00 P M., and 7·00 P M This schedule applies to all week days except Saturday, when the station signs off at 12 30 P M KFKX's wavelength is 288 3 meters

All Stations Placed on Equal Basis

IT has been decided by the Department of Commerce to eliminate all distinction between stations, such as Class "A" or "B" Four years ago, many of the stations radiated phonograph music and some of the more progressive program directors announced that they would broadcast entertainment furnished by artists actually performing before the microphone. The latter transmitters were termed Class "B" and the others were listed in Class "A"

Secretary Hoover said, "From now on all stations will be on the same basis There will be only one test—that is, service to the listener, and this test will be applied to every station, big or little"

Engineers Report on Distortion

NIGHTTIME distortion associated with fading signals depends definitely upon the distance and direction of the receiving set from the broadcaster, according to a study made by engineers of the American Telephone and Telegraph Company, extending over several years, the results of which have been made public. The observations revealed that while reception in the vicinity of the transmitting station may be practically perfect, the same receiver in a more remote area would, after sunset, pick up only very mutilated signals

The investigation brought to light the fact that even daytime signals behave in a peculiar manner Measurements on received signals show that for a given distance from the broadcasting station the waves were by no means of equal strength in different directions

The 309-Meter Voice of KDKA, Pittsburgh. Two streams of water cool the plates of the four 10-kilowatt transmitting tubes. The rubber hose is wound around the cylinder to give length to the column of water and thus prevent it from conducting the high-voltage current from the plate and ruining the set. A column of water that has a small cross section in proportion to length is a poor conductor of electricity

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Cabin of the *Elisabeth* and *Blanche*, the forty-foot lifeboat in which four English mariners will attempt a cruise of 38,000 miles. The transmitter is rated at one-quarter kilowatt. The receiver is a Marconi lifeboat type

Although daytime observations were very interesting, it was found that they did not throw much direct light upon the question of nighttime fading and quality distortion Consequently, a test station was established a few miles outside of Stamford, Connecticut, where, for a period of about a year and a half, many graphic records of the signals were made At night these signals were influenced by fading, and at times became so badly distorted as to be unrecognizable One of the mysterious features of the distortion was its continuous shifting as the signals waxed and waned Kinks appeared in the waves as if they had been battered in transit and these kinks slid about extensively.

Midget Wave Produced

EXPERIMENTERS at the University of Iowa report that they have succeeded in producing a wave one four-hundredths the length used by some of the large broadcasters The Iowans radiated a wave 1 3 meters long, which is a trifle over four feet

Clock Turns Receiver On and Off

A NEW clock, resembling an ordinary alarm clock, has been designed to automatically turn a radio receiver on or off at a specified time It is called the "Radi-o-Larm" The timepiece is easily attached to the radio set by breaking the filament circuit and connecting the two ends to terminals on the clock One advantage is that the clock eliminates the possibility of the tubes burning all night, as it can be set to turn off the "A" battery at a certain hour

Improved Condenser

A VARIABLE condenser, which retains the semi-circular shaped plates but affords straight line frequency tuning, has been produced by the Cardwell Manufacturing Company. This condenser secures straight line tuning by using plates whose thickness is tapered, so that as the plates are rotated, they dovetail more closely, because of the varying thickness of both stator and rotor plates.

Myers Tube Plant Now in Cleveland

THE Myers Radio Corporation will manufacture tubes in the United States. Patent difficulties compelled this concern to stop manufacturing in this country in 1922, and since that time the plant has been located in Canada. A new plant is in operation at Cleveland, Ohio. Prior to December, 1922, these tubes were made in Jersey City. Their type of construction was entirely different from the ordinary style of tube, in that the elements were small, minimizing capacity effects The leads of the plate and positive filament were brought out of one end of the tube and the leads of the grid and negative filament out of the opposite end Expiration of certain patents now enables the Myers Corporation to manufacture in the United States

Radio Trade Meeting

THE fifth annual convention of the National Radio Trade Association will be held at the Hotel Ambassador Atlantic City the week of May 10, according to F E Potter chairman of the committee on annual meetings

May Relieve Inland Stations of SOS Watch

IT is recognized that inland broadcasting stations cannot interfere with the receipt of SOS calls from ships at sea, and therefore it has been recommended that those radio stations which, by reason of their location power and wavelength, cannot, in the opinion of the Secretary of Commerce cause interference with SOS calls, be relieved of maintaining a watch for the distress signals If this recommendation is adopted, the stations will also be relieved of the requirements of having a licensed commercial operator, and a special class of license, which does not require the operator to know the code, will be substituted

Civic Entérprise Puts St. Louis on Radio Map

CIVIC enterprise has built a 5,000 watt broadcaster for St. Louis Missouri Sixteen commercial concerns backed the project and the transmitter is now on the air. It is known as "The Voice of St Louis." Its construction cost $110,000, and it is estimated that the annual cost of operation will be approximately $135,000 The transmitter is located 16 miles from the city, so that interference will be minimized

New Loudspeaker a Departure

A NEW type of loudspeaker, called the Audalion, has been developed by Dr Lee DeForest. It is a complete departure from the cone and horn type devices; and it is said to transmit sound on an entirely different basis—along horizontal and vertical planes instead of in concentric circles The machine is cylindrical in shape, ten inches in diameter, eighteen inches tall and does not employ a diaphragm A specially constructed unit actuates a membrane covering on the outside and this reproduces the sounds.

The Eveready Hour

LIKE the fabled ship in which Jason brought home the enchanted fleece of gold, the Eveready Hour brings a rich treasure of entertainment to charm the harbor-homes of its hearers.

Inaugurated two years ago, the Eveready Hour was an adventure in broadcasting—an hour of connected entertainment, uninterrupted by the frequent injection of the name of the broadcaster.

Many of these programs have become famous. Thousands of letters voice the appreciation of our audience and ask for repetition of favorites. We make no requests for these letters, but they mean much to our artists and to us, and are of great value in helping us in our efforts to arrange programs of a distinctive nature and pleasing to the vast audience

Radio has already become a highly specialized art worthy of the most scrupulous code of ethics, and the Eveready Hour represents a sincere effort to pioneer in providing the most acceptable form of radio entertainment.

Eveready programs cover a wide range of entertainment and human interest, transporting us to periods of wholesome simplicity, to barren islands where marooned sailors meet adventure, starvation and death; to battle-scarred France with singing doughboys; to emotional heights by telling with music the stories of the seasons; and to memories of yesteryear aroused by old ballad and musical comedy favorites.

Eveready Hour begins at 9 p.m each Tuesday night, Eastern Standard Time

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WSAI *Cincinnati*
WWJ *Detroit*
WOC-*Davenport*
WEAR *Cleveland*
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Why Blood Will Tell

Astounding Discoveries About Heredity—Dramatically Revealed

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Albert Edward Wiggam has dedicated his life to making the truth of heredity understandable to the man in the street In his new book, "The Fruit of the Family Tree," he has dramatized for the average man and woman the discoveries of Science regarding heredity and its relation to human progress, making the knowledge of the biological laboratory a matter of immediate personal concern He has translated the findings of the great specialists in biology, psychology, and anthropology into plain, every-day facts, which his gift of vivid, lucid statement makes clear to those who are not specialists but who wish to keep up with this fast advancing Science

Do You Know—

that virtue, intelligence, beauty, ability to succeed in life, capacity to make money, are all largely matters of heredity?

that insanity, epilepsy, nervous prostration, feeble-mindedness, criminal tendencies, are inherited?

that twins are the most wonderful beings in the world?

that most popular ideas about "prenatal influence" are complete nonsense?

that the intelligence of the American people is declining?

that there is only one way to stop the decline?

that science knows the mechanical means of heredity by which virtue and vice, beauty and homeliness, intelligence and stupidity, baldheadedness and color-blindness, tuberculosis and bad colds, are transmitted from parent to child?

Read Albert Edward Wiggam's "The Fruit of the Family Tree"

Here is a book of fascinating interest A helpful book that gives new meaning to Romance It is packed with the good news that Science brings to you for your children It dissipates clouds of fear from the minds of people who have believed much nonsense about prenatal influences pointing out that a new Eden lies in the future here if America will be guided by Science It is a book for fathers and mothers, for young people, for teachers, for legislators, and for business men

"Why should one read fiction for a pastime," says Professor Edward Ainsworth Ross of the University of Wisconsin, "when Mr Wiggam can make the reports from the scientific laboratories so thrilling? His posing of puzzles— as in cousin marriages, twin resemblance, and inheritance of disease—and then the flashing upon the stumped reader of the solution found by the experimenters and the observers of the last twenty years, holds the fascination of a Sherlock Holmes Story "

A Source of Inspiration

"The inspiring thing to me about all this," says Mr Wiggam himself, "is that it gives us such an exalting view of life It proves not that we are slaves, but that we are masters of our environment Some idea of the richness of suggestion and enlightenment that one finds in Mr. Wiggam's book is found in such questions as these which make the reader stop and ponder as he goes from page to page

Albert Edward Wiggam

Do you realize that education can add nothing to anybody's inborn natural mental powers, that education can wonderfully train what one is born with, it can add nothing to inborn capacity, do you know that while the Government knows officially the quality of its best hogs, mules, horses, sheep, cattle, and goats, it does not know officially the quality and ancestry of its best or worst human beings? Do you know why it is that more people go insane during times of peace than in times of war, and why it is that city people produce great men more than twice as fast as country people?

Do you know that Man-o'-War and every other great race horse in the world today have in their veins the blood of Eclipse and Hambletonian Ten, "two horses over one hundred years ago"

Mr Wiggam's conclusions are as constructive as his questions are startling. His book abounds in illustrations of the strange and mysterious growth of famous "Family Trees" One of these is that of the Edwards Family—which includes such names as Jonathan Edwards, Aaron Burr, Mrs Eli Whitney, Robert Treat Paine, Chief Justice Waite, Winston Churchill, Gen Ulysses S Grant, Mrs Theodore Roosevelt, Dr George E. Vincent, and Grover Cleveland.

"The Fruit of the Family Tree" has grasped the imagination and interest of thoughtful Americans as have few other books of this kind It is historic and prophetic Above all, it is a guide-book of sound usefulness for those who recognize the importance of getting acquainted with one's ancestors, and who wish to have their children grow up to the full limits of their inherited capacities.

Here Are the Chapter Headings:

Does blood tell?
What heredity tells, and how it tells it
What education tells
What prenatal influence tells
What twins tell about heredity
What cousin marriages tell about heredity
Is disease inherited?
Is brain power inherited?
Measuring heredity in royalty
Influence of leaders upon national life
Can we make the human race more beautiful?
Woman's place in race improvement
Can we make motherhood fashionable?
Birth control—a two-edged sword
Does heredity or environment make a man?
What you can do to improve the human race

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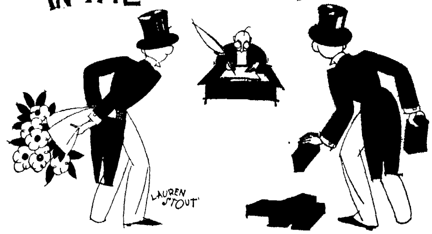
IN THE EDITOR'S MAIL



Appreciation from an Aviator

From Lieutenant Cyrus Bettis, U S A., winner of the Pulitzer trophy in the 1925 Air Races, comes the following encouraging telegraphic message

Editor, Scientific American

You are to be commended for the amount of space devoted to aviation in your December issue Editorial on commercial aviation is especially good All publicity of this sort will certainly hasten the progress of aviation in this country

Bettis

Can a Stone Bend Without Breaking?

Does stone ever bend? Few of us would be likely to answer that question in the affirmative Yet this comparatively rigid material, under favorable circumstances, does sometimes bend, as one of our readers, who has seen a bent stone, writes us

Recently, while walking in the city of Elizabeth, New Jersey, I noticed in a cemetery a horizontal, white stone slab, supported at each corner on a stone column, and bearing a marked sag in its center This aroused my curiosity and I went in to investigate it

As I had my vest pocket camera along, I took a couple of snapshots The top slab measured 6 feet long and 3 feet wide, and the thickness was about 3 inches The material appeared to be white, fine grain sandstone The top slab had an inscription about a woman, concluding with the statement that she died in the year 1831 This inscription was rather faint but could readily be made out

Three years ago as I traveled in Sweden, I saw blocks of granite of a reddish tint with darker wavy bands, as if the mass had been bent while in a pasty state of consistency Later I read an article by a Swedish geologist in which he pointed out that rock under great pressure and under the influence of the ever present, rock dampness, may change shape without breaking, a relocation of the crystals taking place under those conditions.

This theory appears quite plausible, but for my part I never thought I should see a stone bend without breaking, the rare mineral "flexible stone" excepted. In the case presented here, however, it appears that stone, at least some kinds of stone, may bend under certain conditions without breaking, and in such a short space of time as less than one hundred years

G A. Akerlind

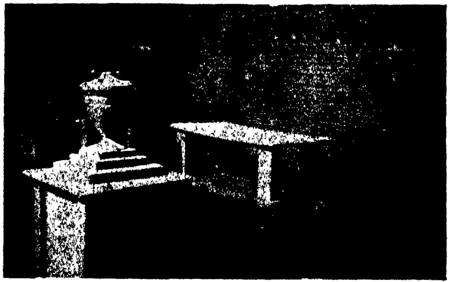
Geologists tell us that many kinds of rock will bend while cold, without breaking This will take place within a short time, if the force is great enough and the rock is confined on all sides, or it will often take place during very long time periods under slight stress In laboratories, rocks have been made to flow while cold, taking up new shapes under extremely high pressure. Much work of this nature was done by Prof C R Van Hise many years ago, and Prof P. W Bridgeman, of Harvard University, whose researches on many kinds of matter under extremely great pressures are noted Man's estimate of rock as a rigid material is based on his own short life of experience. Nature works over millions of years. In exceptional cases, such as the one described by one of our readers, where the rock was thin and poorly supported, a hundred years is often sufficient

Our Prophecy Realized

No one will begrudge us the satisfaction we enjoy in receiving a letter of this kind:

Editor, Scientific American
Dear Sir:

In one of your editions of the Scientific American in the beginning of the year 1924, your editor predicted that a fireless cooker would be made that would reduce to a minimum the expenditure of energy, time and fuel in cooking food That article inspired me to make experiments which resulted in getting a patent on it I have been using it in my own home for a year and have scrapped my gas stove It is a great satisfaction The food is put cold in the pots, then put in the ovens, then the heat


Bent stone monument in the cemetery of St. John's Episcopal church at Elizabeth, New Jersey.- The monument was built in in 1831

The Book Department

The recent discoveries and determinations with regard to the action of ATOMS and ELECTRONS of such men as Millikan and Lodge behooves one to become acquainted with a subject that undoubtedly will, in the near future, very materially affect our industrial processes, even possibly life itself.

With this in mind the following selection of books on the subject will be of assistance to our readers as a means to that end

Atoms and Rays by Sir Oliver Lodge A theoretical treatment of the subject by Great Britain's most prominent Physicist. A masterly contribution to science	$3 15
The Electron; its isolation and measurement and the determination of some of its properties—by Millikan Millikan is to the United States what Lodge is to Great Britain This book fully justifies his position as one of the leading Atomic theorists	2 15
Concerning the Nature of Things by Bragg The author presents in simple language a consideration of the atom, gases, liquids and solids and X-ray analysis In his unique style he makes the profundities of science read like a tale of adventure	3.15
Constitution of Matter by Born Translated from the German. Three valuable essays which deal with their subjects from different points of view They have been carefully brought up to date, incorporating the latest advances	2 65
Atomic Theories by Loring Gives the important theoretical and experimental investigation of the atom and its structure and the arrangement of electrons in atoms, in molecules, and in ions.	5 20
The A B C of Atoms by Russell A thoroughly admirable book for the reader, who, while not familiar with technical physics, wishes nevertheless to be informed of its latest developments	2 15
Ether and Reality by Lodge A series of discourses on the many functions of the ether of space, written for the layman	2.15
Within the Atom by Mills Without mathematical formulation it deals with modern theories as to matter and energy, emphasizing the granular structure and electrical nature of matter	2 15

All prices postpaid

Chemistry and Civilization

By A. S. Cushman

Though many books have recently appeared which seem by title to be similar, none cover the historical aspect in a more condensed, comprehensive manner than this new and revised edition. Published by E. P Dutton & Co. $2.65 postpaid.

Aeronautical Meteorology

By W. R. Gregg

Meteorologist, U S Weather Bureau

Intimate knowledge of the characteristics of the atmosphere is essential to aviation, but it is also of more than passing interest to all those following sports Written for the layman, this book may well be placed in every library. Published by The Ronald Press Co. $2 90 postpaid

Analysis of Financial Statements

By H. G. Guthmann

Asso Prof, Business Admin., Univ of Texas

Explains how the facts presented in a financial statement may be easily and fully interpreted A complete guide for somewhat advanced analysis. Published by Prentice-Hall, Inc $5.20 postpaid.

Science, Religion and Reality

Lord Balfour has written the introduction to this collection of essays by various personages of high repute He does not attempt to explain some of the divergent views, but grants that in all respects independent thinkers cannot be expected to coincide, by the very fact of their independence. Published by The Macmillan Co. $2.65 postpaid.

The First World Flight

By Lowell Thomas

The narrative of the individual and collective experiences of the six World Flyers as absorbed by the author in extended intimate contact with the participants Published by Houghton, Mifflin Co $5 20 postpaid

Blockade Running During the Civil War

By F. B. C. Bradlee

The intimate relation between the military strategic operations, the railroads and blockade running is admirably clarified while the fascinating old reproductions add charm as well as historical importance Published by Essex Institute $7 50 postpaid

Jesuit Martyrs of North America

By J. J. Wynne

Hereto appearing in books or chapters about one or other of the principals, the author has collected and condensed into a general history the record of those pioneers of heroic stature whose work was of the very foundation of our country Published by The Universal Knowledge Foundation $1.65 postpaid.

How Radio Receivers Work

By W. Van B. Roberts

A complete well illustrated treatment of the many phases of radio reception, being specially valuable to constructors. Many significant points omitted in other works are fully covered. Published by Doubleday Page & Co. $1.15 postpaid.

All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.

A novel home-made fireless cooker

is turned on for a little while, then turned off The womenfolk can go shopping, visiting or to work or to church, and when they return the food will be cooked and warm enough to serve Another satisfaction is that when the oven door is open and the heat turned on, the bottom is used for frying, broiling, toasting and heating leftovers

Your magazine has been an education to me in many ways I have for forty years been reading it, and it has helped me It surely must have enlightened hundreds of thousands of others in their different ways of thinking and demonstration

Malcolm J McFarlane

We Are Still from Missouri

We have received a "come-back" from Professor Miethe, the original mercury-into-gold transmutationist He says he obtained gold from mercury only under very peculiar conditions which were probably not duplicated in the Scientific American gold tests, namely, only during interrupted burning of heavily overloaded lamps These conditions actually were duplicated however in the Scientific American gold test, for it was soon found that no arc with the dimensions given in Professor Miethe's reports, using 170 volts, will operate steadily at atmospheric pressure This, therefore, disposes of the Professor's conjectural objections to the outcome of our tests Here is what he writes

Editor, Scientific American

I learn from the daily papers that the scientists who have worked with you to verify my investigations on the formation of gold from mercury have obtained no positive result These gentlemen have expressed the opinion that possibly our original mercury may have contained gold

In a paper which will appear shortly (*Zeitschrift fur Anorganische und Allgemeine Chemie*) I have already disarmed this objection, expressed from another source, by a systematic investigation and we can assert with the greatest safety that the original mercury never contained more than 1/10,000,000 of a *milligram of gold in a kilogram*, or better said, never an amount that could be detected by our present and very refined analytical methods

Although the experiments of the American scientists (who, so far as we know here, used mercury lamps) resulted negatively, this may doubtless be explained by the behavior of the mercury lamps themselves, for I have no reason to doubt the care taken in the experiment in any way We have shown, by numerous experiments (which we have also published) that mercury lamps give gold only under very definite conditions, namely only when through the irregular burning of heavily overloaded lamps, unstable electric processes take

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place in the arc, that is, when temporarily, at least, voltage and current strength are in an unstable ratio to the instantaneous arc length

Meanwhile, as you know, we have also made other experiments since August of last year and, among others, we have constructed apparatus in which the formation of gold takes place in a ratio to the current consumption which can be expressed numerically, and therefore in which the accidental conditions in the mercury lamps can always be systematically repeated in predetermined times

If you desire to concern yourself further in assisting to explain the formation of gold we will gladly send you, if you so desire, my further publications on this subject as they appear Naturally it would be best if one of your scientists would work here in our laboratory once, he would then be able to convince himself in a few days of the reality of the phenomena

Miethe

Spirit Photographs Again

Appreciating the fact that there are two sides to every question we are glad to present for your consideration, a letter from Sir Arthur Conan Doyle giving his views on Dr Prince's article in our December issue

November 26

Sir

I may be doing Dr Prince an injustice by not waiting for the printed version of his remarks, and commenting at once upon the cabled version He will understand however that if I did not do so my reply might be too late for any immediate number of the Journal

Dr Prince makes two charges and I will take them in turn

The first is that I "acclaimed" certain psychic photographs by two young mediums named Falconer and said they were 'marvellous" whereas they were in fact reproductions of well-known paintings

When I first saw these photographs, some eight or nine weeks ago I said they were marvellously artistic which is obviously true I then examined them carefully, recognized that they were *reproductions of paintings* and wrote as follows under date September 20th to the Editor of the *Psychic Gazette*, the letter appearing in the October issue

"Sir I noticed that you used my name in connection with the spirit photographs alleged to be produced by the young Mr Falconers I have had no opportunity of personally testing these mediums and I cannot allow my name to be used in connection with this work I did express the opinion that one of their results was on a higher plane of art than any which I had seen before, but this does not of course necessarily mean that it is genuine

"*There are several points* which they have to meet which are not necessarily final but which are so far suspicious that they are calculated to bring suspicion and scandal upon the cause which we all have at heart One is that the stuff which surrounds the faces is more like shredded cotton wool than any I have seen The use of a lens makes the matter even more dubious On the top of this the figure reproduced in your engraving 4 is unquestionably the well known picture 'Blossoms' by Albert Moore One has a feeling also that No 3 (this was the one which several spiritualists afterwards identified as a Murillo) is also familiar Such cases of transference may conceivably be innocent but I repeat that they are suspicious and that it is not a form of mediumship to encourage"

I wrote a similar letter to "Light" Thus it is perfectly manifest that if there was any "exposure" it was I who made it two months before Dr Prince *ever alluded to the matter*

I will now pass to the second count It is that I exhibited a psychic photograph by one Fallis of Chicago, and that it was a fake The facts are that in my first lecture at New York, I exhibited forty five photographs and only one of these did I declare that I could not guarantee This is the one of which Dr Prince speaks A day or two later Dr Prince wrote to me saying that of his personal knowledge this photograph was not genuine I at once withdrew it and I told my audience that I had done so At the time I thought it was very gentlemanly of Dr Prince to make *his objection in a private letter* rather than in the public press It seems that my conclusion was premature

Your readers can now see that this whole matter is a mare's nest, which differs only from many other such nests in that the Doctor has laid two eggs in it instead of one The incident is typical of the tactics of a certain type of researcher who instead of devoting his time to something which is positive and constructive, turns all his attention to medium baiting or to springing charges upon those who are seriously endeavoring to elucidate these difficult questions Reasonable criticism is to be welcomed but these tactics of pure obstruction, which are compounded of incredulity to everything psychic and credulity to everything scandalous, are an impediment to all progress I trust that Dr Prince will henceforth devote his undoubted abilities to solid work, and cease to waste his own time and mine by petty personal attacks which are below the dignity of that great inquisition in which we are both engaged

Arthur Conan Doyle

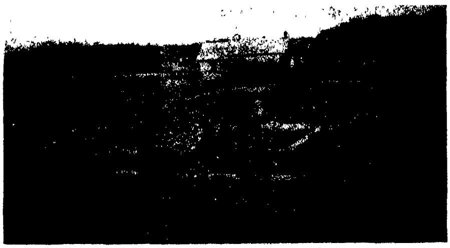
Ingenuity

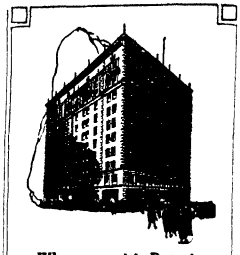
From a correspondent Mr Ralph C Taylor, came this interesting bit of news

The human mind outwitted nature recently near Pueblo, Colorado, when a a bridge contractor constructed a 100 foot steel bridge on the bank and then pulled it into place

Workmen on two occasions constructed the piling and falsework upon which to build the superstructure as is usually done in bridge building On both occasions the creek became swollen with flood waters and washed out the falsework just as the steel work was started

Workmen then built the entire bridge on the roadway When it was completed they constructed the falsework and pulled the span into place before another flood had an opportunity to wreck the piling Timbers were greased and the steel span pulled into place by means of a large tractor on the opposite bank pulling a large cable Only an hour was required to install the bridge which was then bolted to the concrete abutments previously poured.


The bridge, showing how the cable pulled it from the bank to its permanent position across the creek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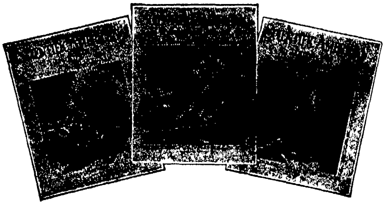

"In the reflecting telescope," declares Russell Porter on page 86 of this magazine, "*the mirror's the thing.* No matter how elaborate and accurate the rest of the instrument, if it has a poor mirror, it is hopeless."

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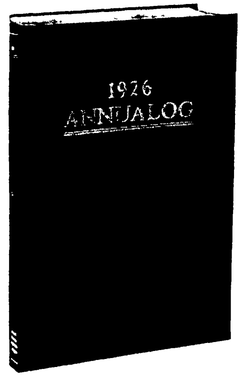

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by **Milton Wright**

What is Commercial Property?

HERETOFORE the Scientific American has carried a department known as "News for Inventors" That many inventors found it interesting is attested by the letters they wrote to the editors concerning it It was of interest to many others also, who were not inventors -manufacturers investors capitalists, attorneys or those in some other line of business activity And they were interested not only in inventions but in patents, trademarks commercial prints and labels, copyrights, unfair competition all the many phases, in fact, of property rights in ideas

Obviously, since the scope of the department had spread beyond the title, the logical thing was to change the title Hence the new legend, "Commercial Property News

The term "Commercial Property" includes tangible property rights of many kinds patents and trademarks copyrights prints and labels—all of which owe their existence to the institution of commerce Such commercial properties have tremendous value and play a dominating role in our present economic system It has been said that eighty five percent of our national wealth is based directly or indirectly upon patents, that seventy five percent of the trade of the country involves trademarked goods, that copyrights affect all our literature and our art and that commercial prints and labels are at the heart of the advertising hub around which the entire cycle of business revolves

Labels for Imports

IN the case of Lewis and Conger against the United States, the Supreme Court sustains the validity of the provisions of the customs laws requiring goods imported to bear a mark indicating the country of origin

The petitioners imported certain merchandise which the New York Collector of Customs detained in his custody, requiring the same to be marked, branded or labeled so as to indicate the country from which it was imported. The Collector's orders were complied with and the goods marked "Made in England," as provided by Section 304 (a) of the Tariff law of 1922.

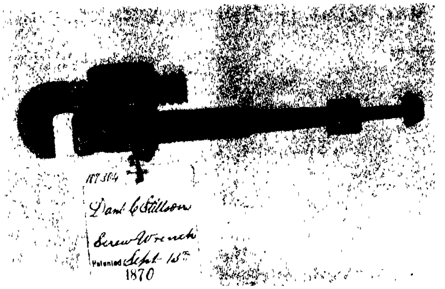
Upon liquidation of the entries the Collector assessed an additional duty of 10 percent *ad valorem* on the ground that the goods had not been properly and legally marked upon entry The Board of General Appraisers upheld the action of the Collector and the Board's decision was affirmed by the Court of Customs Appeals. In its opinion the Supreme Court refused to review the decision of the customs court

Fountain Pen Bargains

PEOPLE like to think they are getting bargains You might get a little tingle, for example, at paying only two dollars for a fountain pen labeled "Morrison's No 33 1/40 14K gold mounted self filling $10"

That pleasure is going to be denied you hereafter The Federal Trade Commission refused recently to allow the Morrison Fountain Pen Company to continue marking its pens that way inasmuch as the company sold the pens to jobbers for one hundred and forty four dollars a gross and they usually retailed at two dollars although occasionally two dollars and fifty cents and three dollars were obtained

"The prices marked upon such pens by the respondents are false and fictitious prices far in excess of the usual retail selling prices" says the Commission "and were placed upon such articles by the respondents with the intent and purpose of misleading and deceiving the purchasing public as to the value and the usual selling prices of such pens"



THE ORIGINAL STILLSON WRENCH

Upon this model Daniel Stillson obtained his patent in 1870. It has been dug out of the Patent Office files and transferred to the Smithsonian Institution. Note the absence of the wooden handle; it was burned off in the Patent Office fire of 1877. This invention probably has been more widely used than any other single article upon which a patent ever was obtained

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion, minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion

Official copies of any patents listed in this section at 15c each, state patent number to insure receipt of desired patent copy

Of General Interest

RADIO STATION INDICATOR AND FINDER—Which can be applied to any type of set in which the dial readings are constant Patent 1553210 E G Ballenger, 805 Healey Bldg, Atlanta, Ga

PHONOGRAPH In which a form of horn is provided giving softer and more pleasant tones Patent 1553633 S J Roguhe, Lewistown, Mont

DRIP SHIELD FOR SHAVING BRUSHES—Adapted to receive the excess water from the brush, and prevent it from dropping down and soiling surrounding objects Patent 1553710 H I Muus, Vancouver Barracks, Washington

FLEXIBLE NOZZLE—For use in guiding liquids from a hose line into various receptacles, particularly tanks of automobiles Patent 1551893 F A McDonald, 1538 Eleventh Ave, San Francisco, Cal

WAFFLE IRON—In which the two sections are each provided with a heat retaining recess, and a novel means for turning the iron Patent 1553989 J E Cook, Box 671, Harrisburg, Pa

PAINT OR PRINTERS' INK SOLVENT AND PROCESS FOR MAKING THE SAME—Whereby ink may be diluted and when used in connection with halftones a clearer and more effective print secured Patent 1553914 J E Rhodes, K Route, Centralia, Wash

METHOD AND APPARATUS FOR EXTRACTING GASES FROM LIQUIDS—Whereby gases can be efficiently and quickly removed from liquids, as they are circulating through the apparatus Patent 1554138 V V Sobenni koff c/o Prosvese Nenevi, 9 Second Ave, New York N Y

PIPE—Having a stem with tortuous passage, effectively cooling the smoke, and preventing nicotine from being drawn into the smokers' mouth Patent 1554537 A F. Teigen, "A" St South, Moorehead, Minn.

POSTURE BOOKREST—Designed for use on desks, tables and other supports, for holding a book in open and upright position Patent 1554970 J A Dugan, Decd, Mary R Dugan, Executrix, 51 Clark St, Brooklyn, N Y

ARTICLE OF FURNITURE—In the form of a novel web assemblage, of ample strength to sustain the springs of sofas or chairs for an indefinite period Patent 1554902 K Balikjian, 95 Clinton Ave, Newark, N J

DEVICE FOR TREATING SOIL—Around plants, by means of a "mulch paper" containing a fertilizer which will be gradually released as the paper disintegrates Patent 1554865 E H Magoon, P O Box 2929, Honolulu, Territory of Hawaii

SMOKEHOUSE—Provided with an arrangement of rotary frames, onto which racks for supporting the articles to be smoked, may be revolved during smoking Patent 1554,906 L Brand, c/o M Brand & Sons, First Ave and 40th St, New York, N Y

PROCESS OF TREATING ORES.—At the mines, by the simple agents of water and fuel without regard for the usual transportation facilities Patent 1554917. G Kunkle, Grand Junction, Colo

CONCEALED COMPARTMENT FOR SAFES.—In which bills of large denomination, jewelry and other very valuable articles may be supported and concealed against casual search Patent 1554900 B Baer, Oakland Ave and Trysting Place, Cedarhurst, L I., N. Y.

MEMORY AID—Which consists of a conveniently printed list of articles, which may be checked, and the checks erased after use Patent 1554480 J S Anderson, 20 N Halsted St, Chicago, Ill

FOUNTAIN TOOTHBRUSH.—Wherein the brush head is connected to a handle with means for ejecting the cleansing material. Patent 1555064 G A. La Mothe, 759 E 138th St, New York, N. Y.

FLUSH TANK—The valve lifting means of which is located at the end, so as not to interfere with the seat. Patent 1555620. J. G. Ayers and G. D. Barnes, Dayton, Tenn.

BRACING STRUCTURE FOR FOLDING BEDS.—Which affords facilities for positively pre-

Patent Troubles in China

AN internationally known firm of patent attorneys receives the following report from its agents in Shanghai

"It has come to our attention that quite a number of Chinese are obtaining patents under the provisional regulations, and as the Ministry of Commerce do not make any examination in order to ascertain if applications or letters patent contravene or infringe upon foreign patents, a number of patents are probably issued on inventions or improvements which will, in fact, infringe patent rights of foreigners While China has not, at the present time, a patent law for the granting of letters patent to foreigners, yet protection for foreign patents may be claimed under the treaties with China For this purpose, the Consulates of the foreign nationals concerned, as well as the Chinese Maritime Customs in Shanghai, accept for filing purposes only, applications for the registration of foreign patents

"The Chinese Government is considering the drafting of a patent law which will be for the benefit of foreigners as well as Chinese It will, therefore, be apparent that obtaining an official date of filing with the Customs and with the Consulate at this time on patents' specifications will, later on, prove of considerable importance in claiming priority of invention in China"

The point of the report is If you have an invention which you think may be of importance in the future in China, apply now for the provisional patent registration at present in force there

Mark Twain, Inventor

ALL of us are familiar with Mark Twain's work as a writer, some of us know of his career as a publisher, but how many of us know of him as a successful inventor? It is a fact that for a considerable period of time he derived a steady income from royalties on one of his three patents

He called it "Mark Twain's Self pasting Scrapbook" The patent was granted to him June 24, 1873, according to P J Federico, writing in the *Journal of the Patent Office Society* Twain realized the importance of being able to prove priority of invention, so, nearly a year before applying for a patent, he wrote to his brother Orion a letter printed in Albert Bigelow Paine's biography of Mark Twain:

> "But what I wish to put on record now," *the humorist wrote,* "is my new invention—hence this note, which you will preserve It is this—a self pasting scrapbook—good enough if some juggling tailor does not come along and ante-date me a couple of months, as in the case of the elastic vest-strap
>
> "The nuisance of keeping a scrapbook is: 1 One never has paste or gum tragacanth handy; 2 Mucilage won't stick, or stay, four weeks; 3 Mucilage sucks out the ink and makes the scraps unreadable, 4 To daub and paste three or four pages of scraps is tedious, slow, nasty and tiresome My idea is this: Make the scrapbook with leaves, veneered or coated with gum-stickum of some kind; wet the page with sponge, brush, rag or tongue and dab on your scraps like postage stamps. Lay the gum in columns of stripes"

The book enjoyed a steady sale for years in its original form and later in an improved form. During the first royalty period twenty-five thousand copies were sold.

Chemical Patents

THE Chemical Foundation, Inc., of 85 Beaver Street, New York City, has published a list of patents owned by it and available for license to all American manufacturers.

venting collapse of the frame at the meeting ends when the frame is extended. Patent 1555168. J. M. Thomas, R. No. 3, Box 192 B, Tampa, Fla.

Loose Leaf Binder.—Having means for holding the bottom and top binder parts in spaced relation for permitting the removal or insertion of leaves. Patent 1554416 F H Crump, 225 E 4th St., Los Angeles, Calif.

Apparatus for Facilitating Window Cleaning.—Readily applied to a window irrespective of its dimensions, in such manner that the sashes may be swung inwardly. Patent 1554488. H E Binkele, 901 N. Spring St., Los Angeles, Cal.

Cable Tightener.—Whereby slack in a cable may be readily taken up and the requisite tension held. Patent 1555351 A Boynton, c/o Frontier Oil Co., City National Bank Bldg., San Antonio, Texas

Belt Buckle.—Having interengaged parts at all times retained in true relation, yet readily disengaged for opening Patent 1555,-764. R Slote, c/o Messrs Slote & Schaffer, 49 E 21st St, New York, N. Y

High Pressure Still —For refining naphtha, gasoline and other petroleum products, which not only heats the liquid to be distilled but caused a thorough circulation Patent 1555761 W. F Schanzlin, 1809 Lakewood Ave, Lima, Ohio.

Adjustable Broom —In which the head supporting the bristles may be increased or decreased in accordance with the use in which it is employed Patent 1555630 R R. Brock, 806 Quincy St, Brooklyn, N Y.

Dispensing Container —From which a predetermined quantity of the contents may be removed, without discharging the remainder. Patent 1555591 J L Larrison, Wharton, N J.

Flexible Gaff - Especially adapted for landing fish after they have been hooked, means being provided for illuminating the gaff for night use Patent 1555748 H M Lutz, 26 S Maryland Ave, Atlantic City, N. J

Animal Trap —Intended to strangle the caught animal, by a loop or snare encircling the throat when the bait trigger is actuated Patent 1555133 J H McLean, c/o Matt Wagner, Clark, Wyoming

Valve —So constructed that after a predetermined volume of water has been discharged, the valve will automatically close Patent 1555755 W A Pratt, 1130 Ave C, Bayonne, N J

Window Seal Strip —Which will close the opening between the sashes when one sash is raised, preventing the passage of flies and the like Patent 1556461 F Thill c/o Saunders, Young & Grann, 144 N E Second St, Miami, Fla

Coupon. — Whereby an organization can stimulate the attendance of the public on their own store, and direct attention to other merchants. Patent 1556515 H E French, c/o Massachusetts Adv & Sales Service, Inc., R. 409, 220 Devonshire St., Boston, Mass

Furniture Element for Shoe Fitting —Comprising a foot-rest board for use in connection with a foot-length measure as used in shoe stores Patent 1556521 D F Hart, 177 W 79th St, New York, N Y.

Gem Mounting —For use in clasps for connecting the ends of necklaces, bracelets and similar articles of jewelry Patent 1556465. F. B. Wendel, c/o Hercules Novelty Mfg. Co., 126 South St., Newark, N. J.

Safety Chest.—The contents of which are protected by a lock, and also an alarm structure, which will operate for a long time Patent 1556519. G. O Gamba, 17 No Park Ave, Rockville Centre, N Y.

Flushing Tank —Especially designed for successful operation in places where the water pressure is low Patent 1556105. N. J. Gondolf, 703 State St, New Orleans, Louisiana.

Holder for Miniature Loudspeaker.—Adapted to hold the speaker in such a position that the bell portion simulates the lips of a figure. Patent 1556010. I. H Fishelov, 5010 N. Troy St., Chicago, Ill.

Spout Can.—With an improved spout for pouring out the oil, and an attached means for perforating the can to cause an even flow. Patent 1555383. H. Ramslie, Delano, Calif.

Roll for Printing Presses and Method of Making Same.—Characterised by an elastic facing which inherently yields to the type and freely assumes a normal smooth state. Patent 1555389. G M Stevens, 938 Harrison St., San Francisco, Calif

Exercising Device —For use in exercising the hyoglossus muscles of the tongue to improve and develop the vocal organ Patent 1556493 W Conway, Box 768, Jacksonville, Fla

Egg Beater.—Adapted for beating eggs, cream, etc., in closed jars and adjustable for jars of different depths Patent 1557364 A. R Headley, Mulberry, Ohio

Bouquet Stay —Particularly adapted for supporting bouquets of flowers as used in floral designs for funeral purposes Patent 1557508 R. L Walthers, Tomahawk, Wis

Heel for Boots and Shoes —Of rubber construction, the worn parts of which may be readily removed and replaced Patent 1557448 W Felstead, 1653 Ferwood Rd, Victoria, B C, Canada

Device for Making Wire Bands from Which Whalebones are Made —Formed of resilient metallic wires embedded in a convenient coating which unites and protects the same for use in corsets Patent 1557365. A. Josse, c/o Office Picard, 97 Rue St. Lazare, Paris, France

Sensitized Element and Mounting Therefor.—Which when used in mounting photographic enlargements, or like subjects, will retain the same in such manner as to present a smooth surface Patent 1557346 F Schwanhausser, c/o Rusling Wood, 218 William St, New York, N Y

Bubble Pipe — Whereby a plurality of bubbles may be blown at one time, and a fair supply of soapsuds retained within the pipe Patent 1557421 I E Cohn, 65 Fourth Ave, New York, N Y

Gas Valve —Which will automatically close to shut off the supply when the temperature reaches a point sufficient to melt a fusible connection Patent 1557313 J H Lindsay, 1117 Jefferson Ave, Brooklyn, N Y

Broom.—In which a threaded attaching member is embedded in the head, by which accidental withdrawal of the head is prevented Patent 1556841 C M Keener, c/o W H Zachry, Atlanta Variety Works, St Charles, Lakeview & Greenwood Aves, Atlanta, Ga

Fuel Briquette and Process of Making the Same —Comprising a fifty percent mixture of fine anthracite and semi-bituminous dust coal, subjected to 1,000 degrees, Fahrenheit, for a short time Patent 1557,-320 J F O'Donnell, Morris Run, Pa

Fastener —Easily manipulated for the purpose of holding papers together in a file or binder Patent 1557998 G H Ennis, 64 Jesup Place, Bronx, N Y

Resilient Grip —Of cohesive and elastic tape, adapted to be wound around the handles of tools and the gripping members of sporting articles Patent 1556781 T E Gjorup, 3454 Pierce Ave, Chicago, Ill

Antifreezing Pump —Having means for permitting the water in the pipe to flow back into the well, and become a prime for the next pumping operation Patent 1557,-949 M Walton, Ullin, Ill

Hardware and Tools

Fishing Tool —Especially adapted for use in straightening and subsequently removing objects from oil or other wells. Patent 1556692 E B Karn and L J Leuthart, Buffalo, Mont

Lock Washer.—Whereby a nut may be held against accidental turning or loosening when applied to a bolt Patent 1558736 J A McCoy, c/o Sparks & Walters, Redding, Calif.

Dolly-hammer Cylinder Front Head —Particularly designed for use in connection with a "Model 8 Waugh" drill sharpener Patent 1559338 M. McHale, Anyox, B C, Canada

Machines and Mechanical Devices

Brick or Block Cutter.—Which minimizes the breakage of the wires and springs used in machines for cutting bricks from solid bars of clay. Patent 1555769 A P. Steele, Statesville, N. C.

Wave Motor —Taking advantage of the vertical variations of the surface of the waves, and adapts itself to the rise and fall of tides Patent 1555682 S H. McKnight, 9 Bentley Ave., Jersey City, N. J.

Windmill. — In which certain of the blades of each sail will receive the wind pressure for more than a half circle. Patent 1555776 W R Twiford, Box 1, 141 North East 1st St, Miami, Fla

Attachment for Paper Joggers —For use with conventional joggers, and including elements for properly guiding the sheets into the jogger as they come from the press Patent 1554590 W A McGarvin, c/o Dunne Bros, 200 New High St, Los Angeles, Calif

Windmill —Wherein the mechanism for transmitting motion from the wind wheel is of such character as to transmit a smooth and powerful movement Patent 1556276 J H Wilson, Mitchell, Neb

Coin Detector For coin operating machines, which functions to automatically weigh and measure the coins so that substitutes are cast aside Patent 1556477 W C Bellows, 2465 Broadway, New York, N Y

Turbine Wheel —Whereby blades can be easily attached to the periphery to form a series of buckets to receive impelling fluid Patent 1556532 P J Maher, 157 E 18th St, New York, N Y

Windmill —In which a plurality of windmills are cooperatively connected for driving motors for use in irrigating farm land Patent 1556715 W M Riggs, c/o The Riggs Bank, Willcox, Ariz

Lifting Attachment for Riveting Machines —For lifting power operated machines over obstructions, in a horizontal plane, for example, the side of a girder Patent 1556693 D Kennedy, 2106 W Cary St, Richmond, Va

Machine for Automatically Applying Covers on Boxes or Similar Packings - Particularly pasteboard boxes or similar packings Patent 1557500 P Nordenfelt and E Frisk, Ostermalmsgatan 41, Stockholm, Sweden

Motion Picture Projecting Machine — With mechanism whereby great lengths of film are saved in the projection of the titles Patent 1557334 P Roble, c/o Joaquin Montoya, 143 W 82d St, New York, N Y

Apparatus for Separating Unburned Coke from the Products of Combustion —The coke being separated from the cinders or clinkers by immersing them in water Patent 1556672 C I Boyer, Box 87, Ridgway, Pa

Spacing Table for Metal Shell-punching Machine - By means of which a metal sheet may be automatically advanced a predetermined distance after each punching operation Patent 1557438 J A and J A, Jr, Dowd, Fall River, Mass

Tide Motor - Including a pair of spaced walls, barges mounted for vertical movement between said walls, and motors carried by the barges Patent 1557787 F D Taylor, 911 Pontiac Ave, Elmwood Station, Cranston, R I.

Pile Cutter —Which will automatically cut the piles of pile fabric, either in segregated rows or entirely across a piece of fabric Patent 1557345 J Schumacher, c/o Schumarzenbock Huber Co Bergenline Ave and Oak St, W Hoboken, N J

Shielded Hoist Controller —In which the switch, the governor, and the gears are entirely encased to preclude the accumulation of dust and the like thereon Patent 1556858 H H Logan, c/o Duro Metal Products Co, 2649 N Kildare Ave, Chicago, Ill

Prime Movers and Their Accessories

Piston Construction —So constructed as to permit the replacement of the rings by removing that portion of the piston upon which the rings are disposed Patent 1553,-548. E W Nagel and H G Zehner, 607 S Solomon St, New Orleans, La

Carburetor — Provided with accurate means for regulating the flow of air past the fuel nozzle at all speeds of the motor. Patent 1555489 A H and E F Spencer, Aurora, Neb

Tank and Outlet Construction — Adapted for controlling and feeding liquid fuel to an internal combustion engine, by means of a main and auxiliary chamber Patent 1555657 G C Glenn, 201 So Wilmington St, Raleigh, N C

Duplex Carburetor.—Having a double lead-in with a valve structure for automatically shutting off one lead-in when the other is turned on Patent 1556526 C G Krebs, 133 Coffey St., Brooklyn, N Y

Spark Plug.—With a removable insulator core whereby the same may be readily disassembled to facilitate the cleaning of the point Patent 1556251 H Sampson, 2318 N E 2d Ave, Miami, Fla

Pertaining to Recreation

Putting Green and Similar Playing Surface Of an artificial nature, formed from crushed cotton seed hulls, for use on golf courses where it is difficult to maintain the regular grass greens owing to arid conditions Patent 1559520 T McC Fairbairn, A S Valdepino and R McCart, c/o Robert McCart, 221 Mills Bldg, El Paso, Texas

Game Apparatus - Which will provide entertainment and amusement to the players without causing any appreciable mental strain Patent 1558690 E P McCollom, Box 263, Baltimore Md

Handball Bat Or striking device adapted to be worn on the hand of a player, either right or left Patent 1558666 J Brewer and H S Wilks, 1142 Vyse Ave, Bronx N Y

Toy —Whereby a part of the toy is caused to move rapidly and a sound thereby produced Patent 1559422 F J Hanley, 71 East End Ave New York N Y

Pertaining to Vehicles

Gasoline Reserve Device —Which may be locked in closed position, to prevent the removal of any gasoline without the proper key Patent 1554814 R Glazner, Seguin, Texas

Dust Guard for Shock Absorbers —By means of which the presence of dust and other extraneous substances in the working parts is entirely excluded Patent 1557314 H H Logan, c/o Duro Metal Products Co, 2649 N Kildare Ave, Chicago, Ill

Rim for Vehicle Tires —In which the retaining ring is constructed of two parts arranged to be drawn toward the center by means of bolts Patent 1558212 C F Wolf, 2528 N Drake Ave, Chicago, Ill

Shock Absorber — Which may be used efficiently with vehicles equipped with balloon tires, the drum being constructed in the form of an eccentric Patent 1557463 N F McNaught, c/o Duro Metal Products Co, 2649 N Kildare Ave, Chicago, Ill

End Gate for Wagons —So constructed as to make the capacity of the wagon body greater than when ordinary gates are employed Patent 1558292 W H Russell, Clarksville, Va

Headlight —Adapted to receive a part of the light emanating from the regular headlight and reflect the same laterally Patent 1556150 N H Rice, 220 E Victoria St, Santa Barbara, Calif

Governor —Adapted to control the speed of the engine of a tractor forming with the usual fan, a unitary structure Patent 1559125 O T Nichol, 2116 No. 16th St, Omaha, Neb

Combined Pressure Gauge and Valve Cap — Which may be readily secured to the valve of a tire to indicate the pressure of air within when manually actuated Patent 1558660 J E Wood, c/o W Lee Provol, Loyal Order of Moose, 155 N Clark St, Chicago, Ill

Cut-out for Tractors — Which will drown the ignition system and stop the engine, when the forward end is elevated or the wheels blocked Patent 1558775 H P Barras, c/o Dr P A Le Bourgeois, Jeanerette, La

Designs

Design for a Printed Fabric The inventor has been granted three patents 68316, 68317, 68318 J Lader, c/o Atlas & Bluhm, 5 White St New York, N Y

Design for a Shoe —Patent 68431 T Davis, c/o Franklin Simon & Co 38th St and Fifth Ave, New York N Y

Design for a Printed Fabric —Patent 68506 L. Bluhm, c/o Phoenix Mfg Co 40 Thomas St, New York N Y

Design for a Vehicle Body — Patent 68521 B Deckhoff, 364 E 170th St, Bronx N Y.

Design for a Chair — Patent 68529 M C Graff, 109 W 8th St, Bayonne, N J

Design for a Coat —Patent 68520 Taube Davis, c/o Franklin Simon & Co, 38th St and Fifth Ave, New York, N Y

Design for a Dress.—Patent 68550 Maude Siegel, c/o Franklin Simon & Co., 38th St. and Fifth Ave, New York, N Y.

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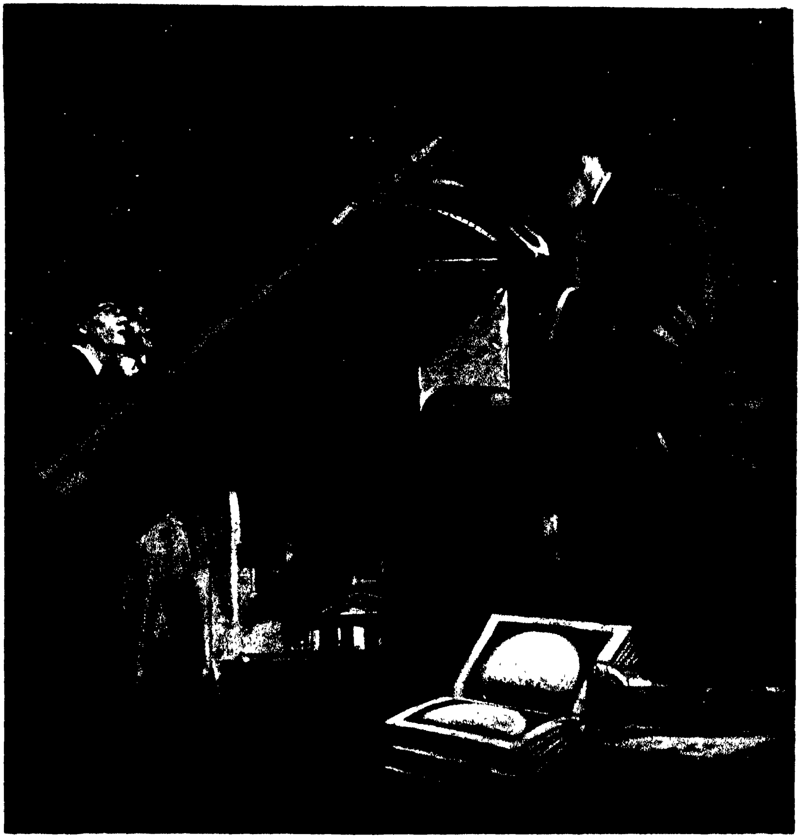

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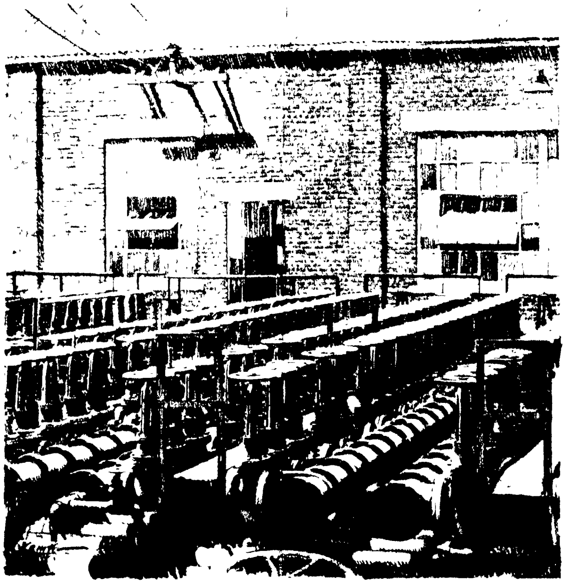

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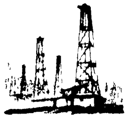
The illustration above is Mid-Continent Petroleum Co. Pump House No. 2 at Tulsa, Okla. Allen and Day, Omaha, engineers and contractors. With a capacity of 1,500,000 gallons a day, it is the largest refinery in its field. Crane valves, fittings and piping materials used.



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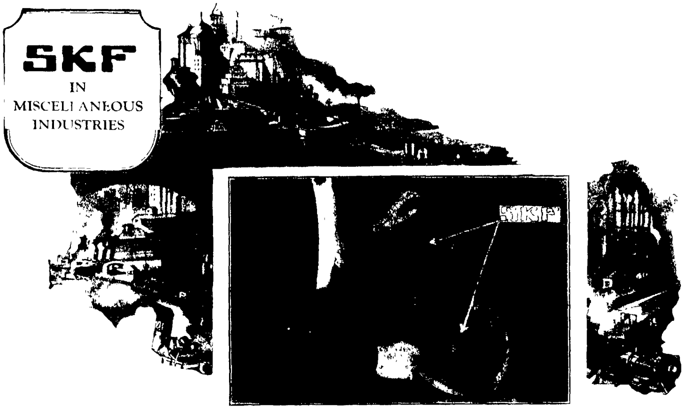

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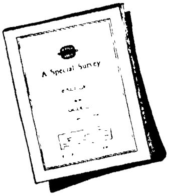

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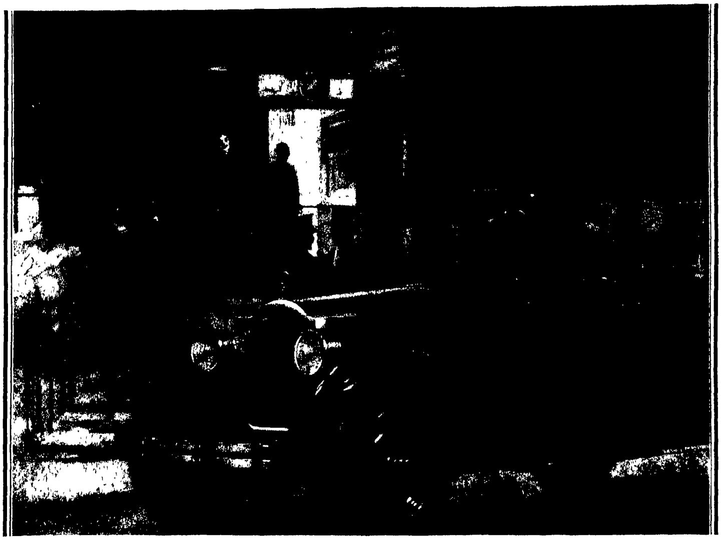

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SCIENTIFIC AMERICAN
THE MAGAZINE OF TODAY AND TOMORROW
NEW YORK, MARCH, 1926 EIGHTY-SECOND YEAR

WASTE

WE are a very rich people. Part of our wealth is due to our ceaseless industry, and part—the greater part—to our enormously rich natural resources—coal, oil, iron ore, magnificent forests. But, for three hundred years, we have been wasting our patrimony. Commencing in our April issue, J. Bernard Walker will tell you in a series of articles, to be published throughout the year, just how extravagant we have been, and what means are being taken by the Government to stop the waste and repair the damage.

RESOURCES

MANY and powerful are the arguments for enforcing a strict conservation of our natural resources and not the least of these is based on the rapid growth of our population. At the last gathering of the American Statistical Association, it was predicted that in the year 2000, New York would have a population of 11,880,000. Shall we be able to feed them? "Yes," says Dr. O. E. Baker, "provided we develop our agricultural lands. We can develop our agricultural resources to support 250,000,000 people; and if we were to use the methods of intensive cultivation of Germany and Denmark, we could support over 400,000,000 people" These are startling figures, but they are based on a thorough study by the most expert minds in this field of research.

EDUCATION

IN his annual report as president of Columbia University, Dr Nicholas Murray Butler sets at the apex of the world's problems the disappearance of "broad men."

"The plain fact is that early and intense specialization is at the bottom of the trouble," he declares "Specialization is the parent of information and of a certain type of skill, but it is the foe of knowledge and the mortal enemy of wisdom. Not narrow men, however keen, but broad men sharpened to the point, are the ideal product of a sound system of school and college education"

An excellent statement in which we heartily concur. The broad man must not shrink when his days within academic walls are over. He must keep up with the achievements of the leaders of thought and action, not only in his own narrow segment, but in the whole sphere of human action. He must know what is going on and what it is all about.

Or, to carry on Dr. Butler's simile, the broad man's fine point must not be permitted to grow dull from lack of use. Constantly it must be whetted on the swiftly turning wheel of progress.

In This Issue

The Truth About the New Cosmic Ray
Rays that reach the earth from some unknown outside source have proved to be far more penetrative than X rays. Much unscientific nonsense has already been written about them Commencing on page 149, Prof. Millikan, the scientist who found out what we know about them, tells you the truth.

Which Mounting for Your New Telescope?
Last month Mr. Porter told you how to make the marvelously accurate mirror for a reflecting telescope. This month, starting on page 164, he explains the fundamental principles of telescope mountings.

What Destroyed This Budding Civilization?
Proof has been discovered that centuries ago the Vikings founded a thriving colony in Greenland. Came adversity, changing climate, unknown causes. The colony died out—was forgotten. Now we find its pathetic remains.

Fresh Air with Closed Windows
Dr. Moore, former chief of the Weather Bureau, has not opened a window in his home for two years, and yet in the hottest weather he has a constant supply of clean, fresh, cool air. Read how he does it. Page 160.

America's Biggest Engineering Project
Guy Elliot Mitchell describes the plan for the complete subjugation of the Colorado River, an undertaking which will cost hundreds of millions of dollars, harness the horsepower from a watershed of 244,000 square miles and cause millions of acres of desert land to become productive.

MORE THAN 175 PICTURES

Complete table of contents will be found on page 216.

For Next Month

Uncle Sam—Spendthrift
We have wasted the rich natural resources of the United States. In no respect have we offended so greatly as in the ruthless way in which we have destroyed our once far-spreading forests The story of former waste and present preservation is told by J. Bernard Walker who has made an exhaustive study of this important subject.

Uncovering Ancient Corinth
Last summer important excavations, that revealed stuccoed walls, mosaic floors and parts of a great Greek theatre of the pre-Christian city of Corinth, were carried out by the American School of Classic Studies Dr T L. Shear, of Princeton University, describes the wonderful finds.

Measuring the Energy of Athletes
Professor A. V. Hill, Nobel prize winner in medicine, is studying the chemical changes which take place in an athlete's organs and muscles when in action. He uses some ingenious methods for his observations and reports surprising results.

Other articles on Coins, Fish Farming, The Super Telescope; Rust; New Arenas of Sport; New Maya Indian Finds, The Truth About Karakul; Death Valley Dates; Radio, Astronomy.

MORE THAN 175 PICTURES

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EINSTEIN

JUST as the Einstein theory had managed to climb into some of the most exalted circles of scientific society and was getting nicely established there, along comes Professor Dayton C Miller with a passion for getting at the facts through experiment and offers it such a shaking challenge as it has not received in years

Professor Miller was busy all last summer repeating the famous Michelson-Morley experiment on top of Mt Wilson, in California, and after making more than 100,000 readings from his delicate, revolving interferometer he now announces his conviction that he has proved the existence of an ether drift If he turns out to be right, this knocks one leg from under relativity

After all, no matter how we feel about it, facts are facts, and the flag of science follows the truth wherever it can find it. Of course, the matter is by no means settled yet, one way or the other.

FAME

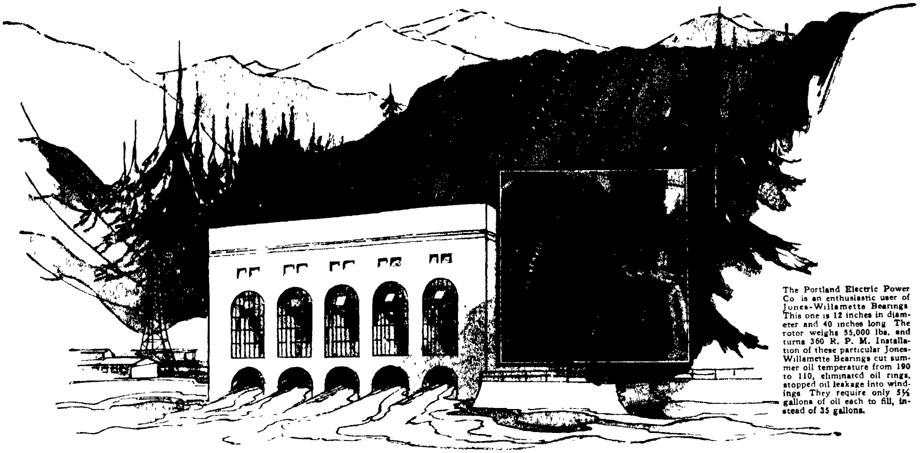
"WHEN the history of recent stellar astronomy comes to be written, some living names such as H N Russell, Shapley, Eddington, and Jeans will shine as stars of the first magnitude."—this is what Sir Oliver Lodge, the world's most noted scientist, says in *Nature* about Professor Henry Norris Russell, of our editorial staff

Twenty-six years ago, an obscure graduate student from Princeton University submitted to us an article about the stars. Ever since then, with almost unbroken regularity, the same author has written a monthly article for this magazine From obscurity, Professor Russell has passed during these years to scientific note, especially because he took the leading part in the development of the theory of stellar evolution

We rejoice that we are still able to present to our readers a monthly review of the progress of the sciences of astronomy and astrophysics, written by so high an authority

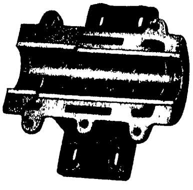
PIONEERING

BE sure to read carefully the article on the Alaska Railroad, written by its general manager Some of you may take a trip over this line some day. If so, remember that it was built by the United States Government to develop a vast territory, that was without means of traffic communication with the outside world. From your car window the country will look very wild and few towns will be passed, but for hundreds of miles on each side of the line is a vast territory which this government railroad has placed in touch with the United States.



The Portland Electric Power Co is an enthusiastic user of Jones-Willamette Bearings This one is 12 inches in diameter and 40 inches long The rotor weighs 55,000 lbs. and turns 360 R. P. M. Installation of these particular Jones-Willamette Bearings cut summer oil temperature from 190 to 110, eliminated oil rings, stopped oil leakage into windings They require only 5½ gallons of oil each to fill, instead of 35 gallons.

New economies result in power plants after the installation of Jones-Willamette Bearings



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Dr Millikan looking into the eyepiece of the lead-sheathed electroscope with which he investigated the cosmic ray

Cosmic Rays

Radiation 10,000,000 Times the Frequency of Visible Light Has Just Been Added to the Growing Gamut of Ethereal Waves

By R. A. Millikan

Director, Norman Bridge Laboratory of Physics, California Institute

THERE has been much newspaper publicity given to the report that I made on "High Frequency Rays of Cosmic Origin" at the meeting of the National Academy of Sciences on November 9 at Madison, Wisconsin The only official report of that address which I have submitted for publication to any journal appears in the "Proceedings of the National Academy of Sciences" for January I wrote out hurried notes of my address for the guidance of the newspaper men who were at Madison for the sake of reporting to their various news services the proceedings, and these notes were shown to as many of the newspaper men as asked for them, but merely for the sake of guiding them in getting as correct a report as possible for their services They were not intended as a scientific publication

For the sake of assisting in correcting so far as it is possible to do so by a very condensed statement, such misunderstanding as may have arisen from the reports that have gone out, I am herewith responding to the request of the editor of the Scientific American to make a very brief statement of the history of the experiments upon these rays and of the new results obtained within the past four years by I S Bowen, Russell M. Otis, G. Harvey Cameron, and myself

Early Experiments on Penetrating Rays

It was as early as 1903 that the British physicists, McLennan and Rutherford, reported that the rate of leak of an entirely enclosed electroscope could be reduced as much as 30 percent by surrounding it with walls of iron or lead a couple of inches thick This proved that the normal leak of an electroscope is due in part to rays that are able to pass through a centimeter or more of lead and then ionize the gas inside of the electroscope. The rays having this property were therefore called "the penetrating radiation of the atmosphere," and were at first assumed to be due to radio-active materials in the earth and atmosphere, and this is in fact the origin of the greater part of them

In 1910, however, Gockel, a Swiss physicist, took up electroscopes in a balloon to a height of 13,000 feet, and reported that he found "the penetrating radiation" about as large at this altitude as at the earth's surface despite the fact that if the rays had their origin in radio-active materials in the earth and in the atmosphere they would have been expected to show a decrease with altitude. Between 1911 and 1914, Hess, another Swiss physicist, and Kolhorster, a German physicist, repeated these balloon measurements of Gockel's, Kolhorster ascending to a height of 9 kilometers, or 5.6 miles Both men reported that they found the penetrating radiation decreasing a trifle for the first mile or so, and then increasing until it reached a value at an altitude of 9 kilometers, according to Kolhorster's measurements, eight times as great as at the surface This seemed to indicate that the penetrating rays came from outside the earth and were therefore of some sort of cosmic origin If so it was computed from the Hess and Kolhorster data that the hypothetical rays would have to produce in an enclosed electroscope sent to the top of the atmosphere an ionization at least forty times as great as at the earth's surface

The Truth about the Millikan Ray

A short time ago the announcement was made that a new kind of ray had been discovered by Dr. R. A. Millikan. To account for this ray, various misleading or inaccurate explanations were given publicity by the newspapers.

The editor of the Scientific American, therefore, appealed directly to Dr. Millikan himself, asking him to write out an authoritative account of his discovery. The article which appears on these pages was received in reply.

Dr. Millikan is best known to the layman scientist by his book, The Electron, in which he explains how he isolated the electron and actually "weighed" single individuals of these infinitesimally small bodies. For this research and for his work on the light-quant he received the Nobel Physics Prize. Dr. Millikan is too well known to need further introduction.

Tests Ten Miles High

In 1915 I made plans to test this point by sending up electroscopes to as near the top of the atmosphere as we might hope to come but on account of the war it was necessary to postpone further plans in this direction In the fall of 1921, however, Mr I S Bowen and myself designed, with the aid of the instrument maker Mr Julius Pearson, some electroscopes that we succeeded in sending up from Kelly Field Texas in the spring of '22 to altitudes of 15.5 kilometers or nearly 10 miles Our results agreed with those of the European observers in indicating a larger ionization inside our electroscopes at high altitudes than at low, but they proved conclusively that the intensity of ionization at high altitudes was not over one fourth that which had been predicted from the Hess-Kolhorster data This meant that the rays of cosmic origin, if they existed, were very much harder or more penetrating than the European observers had imagined or else that the observed ionization was due to materials of some sort existing in the atmosphere itself in which case it would presumably be of ordinary radio-active origin and hence have the absorption coefficients of ordinary gamma rays

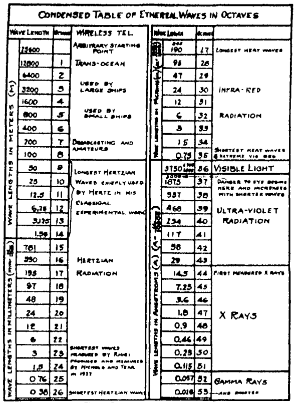
Accordingly, Dr Russell Otis and myself in the summer of 1923, carried 300 pounds of lead and a 6 x 6 x 6-foot tank of water to the top of Pike's Peak in order to find by absorption measurements what kind of penetrating power the rays existing at that altitude actually had. Our results showed that although the penetrating radiation found on Pike's Peak was about twice as strong as that found at Pasadena, the great majority of it was indeed soft radiation, no more penetrating than gamma rays of radium, and we got evidence, too, from the fact that our electroscope leaks inside 5 centimeters of lead were reduced by a heavy snowstorm, that the penetrating rays there found were primarily of local origin.

In a word, these Pike's Peak experiments showed, like the sounding balloon experiments, that if penetrating rays of cosmic origin exist at all, it is necessary that they be very much more penetrating than any one had thus far assumed, going through such screens as we had taken to Pike's Peak without appreciable weakening, and further that they produce in our electroscopes no more than about 1 ion per cubic centimeter per second in the atmosphere at the earth's surface out of the 11 ions that we observed, and which is about the usual number observed in an electroscope at sea level. This meant that it was hopeless to attempt to obtain crucial tests as to the existence or non-existence of these hypothetical cosmic rays unless we could go to very high altitudes where the rays, if they existed, might be expected to be three times as intense as at the surface, and where we could also obtain enormously larger quantities of absorbing material than we had been able to take to the top of Pike's Peak. The only crucial test, therefore, which we could think of for the existence or non-existence of these rays, was to be found in sinking our electroscopes to various depths in snow-fed lakes situated at very great altitudes.

Rays Shoot Through Space

During the summer just past, Mr. G. Harvey Cameron and myself made somewhat elaborate preparations for making such tests, going first to Muir Lake (altitude 11,800 feet), a beautiful, very deep, snow-fed lake just under the brow of Mount Whitney, the highest peak in the United States. We sought a snow-fed lake because our own preceding under-water experiments had been vitiated by our discovery that the waters were radio-active, and we thought that that error might also have inhered in all preceding under-water experiments, and particularly in experiments in crevasses in glaciers, such as Kolhorster had recently made. The results of our summer's work were, very briefly, as follows.

At the surface of Lake Muir our electroscopes showed a rate of discharge corresponding to 12.4 ions per centimeter per second. *As we sank the electroscope to greater and greater depths this rate of discharge decreased continuously down to a depth of 50 feet, after which it became constant at a value of 3.4 ions per cubic centimeter per second.* No preceding under-water experiments had revealed a decrease in ionization below the value found at the surface more than about a fifth or a sixth part of that here found. This meant that we had obtained much more unambiguous and thoroughly quantitative evidence than had before been available for the existence of an extraordinarily penetrating radiation, indeed, so hard that, if it came from outside the atmosphere, it required 50 + 23, or 73 feet of water, the equivalent of more than 6 feet of lead, to absorb it entirely. The 23 feet in the foregoing is the water equivalent, so far as absorption is concerned, of the atmosphere above Muir Lake. How uncertain has been the evidence heretofore is well shown by the fact that one of the most careful and reliable of the German physicists, Hoffman, has just published a paper in November, 1925, in which he thinks he proves that these hard rays do not exist at all, the results all being accounted for by radio-active impurities.



CONDENSED TABLE OF ETHEREAL WAVES IN OCTAVES

	Wave Length	Octave	Wireless Tel.		Wave Length	Octave	
Wave lengths in meters (M)	25600		Arbitrary starting point	Wave lengths in microns (μ)	190	27	Longest heat waves
	12800	1	Trans-ocean		95	28	
	6400	2			47	29	
	3200	3	Used by large ships		24	30	Infra-red radiation
	1600	4			12	31	
	800	5	Used by small ships		6	32	
	400	6			3	33	
	200	7	Broadcasting and amateurs		1.5	34	
	100	8			0.75	35	Shortest heat waves & extreme vis red
	50	9	Longest Hertzian waves chiefly used by Hertz in his classical experimental work	Wave lengths in Angstroms (A)	3750	36	Visible light
	25	10			1875	37	Danger to eye begins here and increases with shorter waves
	12.5	11			937	38	
	6.25	12			468	39	Ultra-violet radiation
	3.125	13			234	40	
	1.56	14			117	41	
Wave lengths in millimeters (mm)	781	15			58	42	
	390	16	Hertzian radiation		29	43	
	195	17			14.5	44	First measured X rays
	97	18			7.25	45	
	48	19			3.6	46	
	24	20			1.8	47	X Rays
	12	21			0.9	48	
	6	22			0.46	49	
	3	23	Shortest waves measured by Rhigi produced and measured by Nichols and Tear in 1922		0.23	50	
	1.5	24			0.115	51	
	0.76	25			0.057	52	Gamma Rays
	0.38	26	Shortest Hertzian wave		0.016	53	—and shorter

Courtesy of the "General Electric Review"

THE ENTIRE KNOWN GAMUT OF ETHER WAVES

Thanks to Dr. Millikan, the following data must now be added under the right-hand column "0.0004 A to 0.00067 A—Cosmic or Millikan Rays"

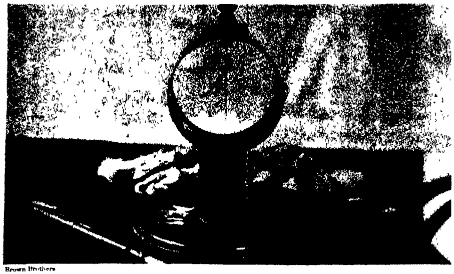
To get crucial tests as to whether the hard rays here observed were of cosmic origin or not, we next went to another very deep snow-fed lake, Lake Arrowhead, in the San Bernardino Mountains, 300 miles farther south, which has an elevation of 5,125 feet, and where the Arrowhead Development Company put all their conveniences at our disposal. The atmosphere between the two elevations of Lake Muir and Lake Arrowhead has an absorbing power for any very penetrating rays equal to about 6 feet of water. If the rays that we observed at Muir Lake all came in from above and if there were no rays at all generated in the atmosphere between the two lakes, we expected to find that each electroscope reading at a given depth below the surface in Arrowhead Lake would be the same as the reading at a depth 6 feet farther down in Lake Muir, the atmosphere between acting merely as an absorbing screen, and *as a matter of fact in both our electroscopes we did find this prediction very beautifully verified.* Our proof, therefore, is now quite definite and unambiguous that there is an extraordinarily hard radiation coming into our atmosphere from outer space. Further, *since at all the altitudes at which we have experimented we find no measurable variation in the intensity of these rays at any time between midday and midnight, we conclude that these rays shoot through space equally in all directions.*

A Wavelength of .0004 Angstroms

By the use of a formula of probable, though not of certain reliability, we can translate the observed absorption coefficients into frequencies or into the inverse of frequencies, namely, wavelengths. By so doing, we find that our hardest observed rays, those which our curve of variation of electroscope-leak with depth in water shows to have an absorption coefficient of 18 per meter of water, have a wavelength of .0004 A. This corresponds to a frequency at least fifty times that of the hardest gamma ray, a thousand times that of the average X ray, and about ten million times that of ordinary light.

Our experiments further showed that these rays of cosmic origin are hardened as they go through the atmosphere, just as X rays are hardened in going through lead, and thus *we infer that we are working with a region of spectral frequencies about an octave in width and ten million times above the octave of optical frequencies to which our eyes respond.*

This is a condensed statement of the facts about cosmic rays which the work of Mr. Julius Pearson, Mr. I. S. Bowen, Mr. Russell Otis, Mr. G. Harvey Cameron, and myself have brought to light within the past four years.



Brown Brothers

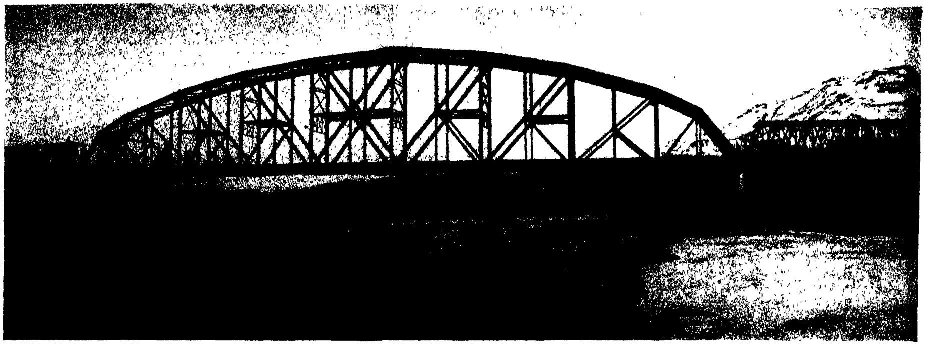
THE ELECTROSCOPE, A SIMPLE INSTRUMENT FOR MEASURING ELECTRIC CHARGES

As the charge leaks off, the two little strips of gold leaf fall together. X rays, cosmic rays and other rays discharge the electroscope at a measurable rate

Brown Brothers

X RAYS DISCHARGING AN ELECTROSCOPE AT THE DEPARTMENT OF PHYSICS, NEW YORK UNIVERSITY

Were this electroscope sheathed in lead, the X rays would be excluded. The cosmic rays, however, penetrate even the lead, discharging the electroscope



THE SUSITNA RIVER BRIDGE

This fine steel span, 504 feet long by 40 feet deep, 265 miles from the coast

Our Alaska Railroad

How the Building of This Railroad in the Face of Colossal Obstacles Opened the Far North to Freight and Passenger Traffic

By Noel W. Smith, General Manager

THE object for which the great task of building the Alaskan Railroad was undertaken and carried to completion in the face of colossal obstacles in an almost uninhabited country was not for the development of the country that can be seen from the car window, but for the development of a vast area hundreds of miles from the rails.

Viewing the broad field for development, the cost to the Government, after two years of actual placing in operation of a standard-gage line, above the earnings received, is of little importance This deficiency, however, looms large in the minds of some people who have not traveled far beyond the line of the road and who appear to have overlooked the fact that our Government, by land grants, made possible the construction of our transcontinental railroads

The railroad is operated continuously every month in the year. Though the amount of freight and number of passengers handled during the winter are small, it is important for the proper development of the service that such service should be performed The roads so far constructed in Alaska are not hard surface roads They are built by covering the grade with gravel and are suitable only for wagons, automobiles and light trucks Only when the grades of these roads are frozen, can very heavy loads be hauled over them Mining machinery, coal, oil, ore and similar commodities can be more economically transported in the winter season for this reason In fact, heavy loads can not be transported at all when the roads are not frozen In some locations no summer roads exist—there are no bridges built over streams, lakes and swamps which can be safely crossed when frozen Certain lumber operations can be conducted in the winter better than in the summer, as is the case in all such operations All winter activities can be more economically performed and, therefore, the development of the country advanced, if the railroad is in operation

CONSTRUCTION DETAILS OF THE BRIDGE

View looking through the 504-foot span showing the impressive end portal, and the overhead sway bracing

Operates All the Year Round

The morale of the railroad employees, as well as that of all other winter residents is improved by reason of being in constant touch with the outside world, being able to get their mail and to travel back and forth.

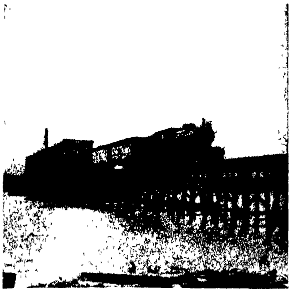
The Alaska Railroad extends from Seward, an open port on the Gulf of Alaska, to Fairbanks, 470 miles northward, connecting at Nenana, 411 miles from Seward, with the interior river system

The term "open port" may need some explanation Contrary to what would be supposed and to the usual impression, Seward and other ports on the Gulf of Alaska are open to vessels every month in the year and the difficulties in docking vessels because of interference from ice are practically negligible, less than those experienced at Baltimore or Philadelphia.

The Alaska Railroad is operated every month of the year. The climate varies as to temperature and snow fall on different sections of the line, but only on two sections, namely, where the line crosses the Chugach Mountains, which are parallel to the Coast, and the Alaska Range, which is the divide between the drainage area to the Gulf of Alaska and the Yukon basis, are rotary snow plows necessary to keep the road open.

There are two important branches, the Chickaloon Branch from Matanuska to Chickaloon, 37 7 miles, from which there are three spur tracks to the coal mines, and the Chatanika Branch, which is a narrow-gage line and a part of the old Tanana Valley Railroad. This branch passes through the placer gold fields of the Fairbanks District There is also a four-mile spur track from Healy to the mines of the Healy River Coal Corporation It will be noted that the main line of the railroad is approximately the same length as the Pennsylvania Railroad between Chicago and Pittsburgh

The road runs in a general northerly direction from Seward on to the Gulf of Alaska to Fairbanks,



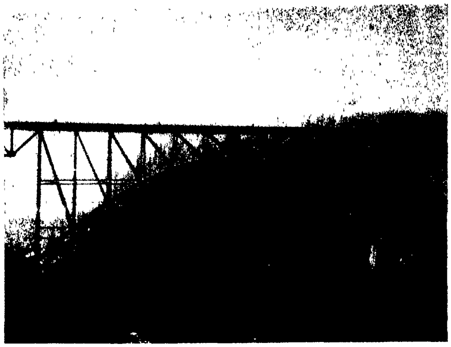
CROSSING THE RIVERS

Much of the work was necessarily of a temporary character Hence timber trusses and pile trestles were used

Courtesy of Alaska Moving Pictures Corporation

ALASKA CANNOT DAUNT THE MOVIE MAN

The "movie man" is ubiquitous. Here we see the train of a large moving picture corporation filming gold rush scenes amid the eternal snows of the Cheechakos



CANYONS CANNOT STOP THE BRIDGE BUILDER

Although many of the lesser structures on the line are of timber, the more important structures, such as this fine trussed arch bridge, are of steel

a distance of 470 miles, and it has to overcome two mountain ranges, one not very far from the coast and running approximately parallel thereto, the other and higher range being the continental divide. Leaving Seward, the line climbs the Chugach Mountains above mentioned, on a grade of 2.2 feet in each hundred feet, to Divide, which is twelve miles from Seward. After a short descent on the same grade, the run is on an easy grade to a point 40 miles from Seward where it again climbs the mountain, on a grade two feet in a hundred, to the summit at Grand View where the elevation is 1,063 feet. From the summit, the line falls on a grade of 2.2 feet to the hundred to the southern end of Turnagain Arm of Cook Inlet. Because of the steep slopes of the mountain and for other topographical reasons, it was necessary, in order to keep the grade from becoming too steep, to build a loop which is recognized as being a fine example of engineering skill. From mile 60, the line runs on an easy grade to Anchorage, 114 miles from Seward.

Forms Link with United States

Anchorage is the railroad headquarters, and the repair shops are located there. The relation between Seward and Anchorage is not unlike the relation between New York and Philadelphia. Both are seaports, but Seward is an open port almost directly on the Gulf of Alaska, while Anchorage can be reached by water only after a long journey on Cook Inlet. Moreover, ice conditions permit the operations of vessels to Anchorage but seven months of the year.

From Anchorage the railroad passes through the valley of the Susitna River and follows the headwaters of that river, crossing the Alaska Range, which is the continental divide of Alaska, through the Broad Pass.

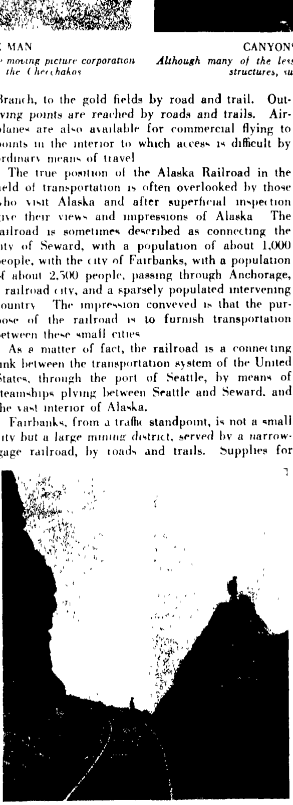
The summit, 310 miles from the coast, is the highest point on the line, with an elevation of 2,364 feet. The maximum grade encountered is one of 1.75 feet in one hundred feet. From the summit the railroad follows the headwaters of the Nenana River and the river itself to Nenana, where the Tanana River is crossed. Between Nenana and Fairbanks, 170 miles from Seward, the railroad, while it is parallel to the Tanana River, is in the valley of Gold Stream. The elevation of Nenana is 362 feet, and of Fairbanks, 448 feet.

At Nenana, connection is made with river boat service on the Tanana and Yukon rivers; at Fairbanks, with a narrow gage, from the Chatanika Branch, to the gold fields by road and trail. Outlying points are reached by roads and trails. Airplanes are also available for commercial flying to points in the interior to which access is difficult by ordinary means of travel.

The true position of the Alaska Railroad in the field of transportation is often overlooked by those who visit Alaska and after superficial inspection give their views and impressions of Alaska. The railroad is sometimes described as connecting the city of Seward, with a population of about 1,000 people, with the city of Fairbanks, with a population of about 2,500 people, passing through Anchorage, a railroad city, and a sparsely populated intervening country. The impression conveyed is that the purpose of the railroad is to furnish transportation between these small cities.

As a matter of fact, the railroad is a connecting link between the transportation system of the United States, through the port of Seattle, by means of steamships plying between Seattle and Seward, and the vast interior of Alaska.

Fairbanks, from a traffic standpoint, is not a small city but a large mining district, served by a narrow-gage railroad, by roads and trails. Supplies for this district, while they are shipped chiefly from Seattle and Pacific Coast points, come from all parts of the United States, and the gold produced adds to the wealth of the nation. Without the railroad, few, if any, of the activities of the district could be carried on.



CURVING THROUGH A ROCK CUT

The survey for the line follows the windings of the river valleys, and many rock cuts had to be made, as here, through the projecting bluffs

Nenana is the junction of the railroad and the interior rivers. The Alaska Railroad operates steamboats between Nenana and Holy Cross on the Yukon River for a distance of 720 miles, taking in supplies, bringing out products and carrying passengers, not only for the country along the river but for points on down the river. These products and passengers are subsequently transported by small boats and the vessels of the Northern Commercial Company to St. Michael, Nome, the Iditarod country, points on the Koyukuk River, and to other tributary country by the use of roads and trails.

Earnings Gradually Increasing

The American Yukon Navigation Company operates steamboats between Dawson and Nenana. These boats connect by steamboat service between Dawson and White Horse, and by the White Pass and Yukon Railroad between White Horse and Skagway, and with steamship service between that point and Vancouver and Seattle. Ore concentrates from the Stewart River country are delivered to the railroad via this route for transportation to the States for smelting. Oil and gasoline are the principal inbound shipments via this route, but other supplies in small quantities are moved. It is a popular tourist route; but it is limited by difficulties in obtaining outbound passage from Seward. From various points along the line, roads and trails connect vast areas, some of them producing, others, in the process of development or exploration, giving promise of becoming important producing fields in the future. Additional roads and trails as well as the extension of the present ones are needed for the development of these and similar fields.

The operations of the railroad, like other Government departments, are conducted on a fiscal year basis. The earnings for the rail line, not including the river boat service, for the fiscal year 1924 were $907,174; expenses, $2,643,750; deficit, $1,736,576; the earnings for the fiscal year 1925 were $797,440; expenses, $2,324,155; deficit, $1,526,715. Included in the deficit shown for the fiscal year 1925 is the $280,040 charged to expenses on account of replacement of bridges and trestles, making the charges to actual maintenance and operating expenses $1,246,-

675. This charge was due to charging the expense portion of roadway and equipment expenditure to expenses in accordance with Interstate Commerce Commission rules, which was not the practice in 1924. Therefore, the operation costs of the road were decreased approximately half a million dollars in the year 1925.

It will be noted that the earnings also decreased; but the showing is quite satisfactory when it is explained that the decrease was due to the discontinuing of certain activities of the railroad which produced gross revenue but which were conducted at a loss, and because of a temporary decrease in the shipment of ore concentrates.

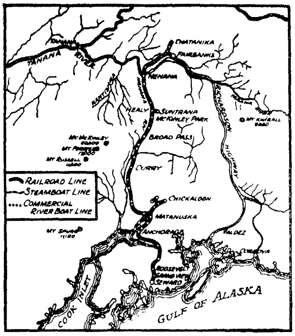
It will be observed that the trend of traffic is upward and therefore encouraging. Viewing the situation by comparison with that of a year ago, it is even more so.

Alaska's Resources Now Better Understood

There is a much better understanding of the value of the mineral and other resources, their limitations and the proper method of procedure for development. Much harm has been done to Alaska by extravagant and exaggerated statements as to the wealth of its resources on the one hand and by incorrect statements on the other as to the lack of value of its resources. It is now realized to a much greater extent than ever before that Alaska has resources, but, like any other country, hard work and ample capital are needed for their development. This capital is now welcome, while formerly any offers of financial assistance were looked upon with suspicion.

The maintenance of way and structures expense offers the greatest field for reduction in expenses, due to the unfinished conditions and number of temporary structures. The members of the Alaskan Engineering Commission had to contend with the most serious difficulties in locating and building a line of railroad through the wilderness. Knowledge was lacking on many important matters. Too great praise can not be given the Commission for the accomplishment of this project in the face of a good many obstacles.

Prior to the authorization of the construction of the Alaska Railroad, the Alaska Northern Railroad had been built northward from Seward for a distance of 71 miles, but was not a financial success. This railroad was purchased by the Government but had to be rehabilitated and in part reconstructed. The Tanana Valley Railroad, a narrow-gage line, had been built from Fairbanks to Chena and to Chatanika. River boat traffic for Fairbanks was handled at Chena because the depth of water in the Chena Slough at Fairbanks is not sufficient to allow steamboats to come to Fairbanks, except in periods of high water. The Tanana Railroad was also purchased by the Government and construction was undertaken from the Seward end of the line northward.



MAP OF THE ALASKA RAILROAD

The length of this Government railroad, from Seward on the Gulf of Alaska to Fairbanks, is 470 miles

The necessity for pushing the ends of steel on each of the sections in the short working season made it imperative that every expedient for advancing the work be used. Embankments in many instances were not raised to the adopted profile, a limited amount of ballast was placed under the ties; trestles built of spruce cut along the line were built where such construction would save time, and bridges, with few exceptions, were built on pile foundations, much of the piling being of native spruce.

In many cases, due to the frozen condition of the ground and other reasons, the penetration of the piles was extremely small. Cuts and fills in many cases were not made as wide as desirable and bank protection was deferred until the line was connected through. Until these conditions can be corrected, the cost of maintenance must be high. The life of the native spruce piles is found to be short and heavy renewal, or replacement, is now becoming due. As rapidly as funds are available, these bridges and trestles are being replaced by steel, concrete or solid fills with necessary culverts. Banks and cuts are being widened and additional ballast is being placed under the ties. As these improvements progress, the cost of maintenance will proportionately decrease.

Economies are also possible with more modern and up-to-date rolling and floating equipment, by the use of hydroelectric power for power and light, and by the expenditure of money for improvements of various kinds.

In placer mining, the small mines are passing, but large dredging operations have subsequently taken their place.

Load mining has been neglected in the past, because the old-time Alaska miner was a placer miner; but it is receiving much attention now. A gratifying advance was made this year in this field, the greatest progress being made in the Willow Creek district, which is about 160 miles by rail north of the city of Seward.

Should Eventually Be Self-supporting

The coal mines have been improved and a new mine, the owners of which are possessed of ample capital, has been opened. Alaska coal has been praised by many and condemned by others and has frequently been described in a manner that would indicate that there is but one kind of coal. All kinds of coal are mined in Alaska, from very recent lignite to anthracite. Lignite of a very good quality and bituminous are mined commercially. Cannel coal and blacksmith coal are mined in small amounts. About half of the commercial tonnage of the railroad is coal for domestic use, power plants and dredges. A small quantity is used along the Alaska coast, especially by canneries, and such use should increase materially as the cost of production decreases.

Lumber operations and fur farming show gratifying increases over last season, and agriculture and other activities, a slight increase. Tourists are coming to Alaska in increasing numbers, as well as large game hunters. The prospects are favorable for a steady growth in traffic on the Alaska Railroad which, coupled with decreased maintenance and other costs resulting from improvements, should eventually make it self supporting. Such a situation, however, can not come about immediately, and should not be looked upon as the fulfillment of the purpose of the railroad.

IN THE MOUNTAIN RANGE

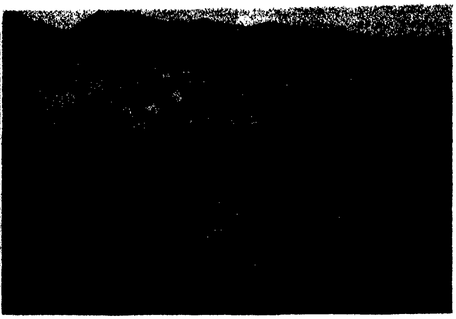
In the foreground is the main track, in the middle distance is a stretch of snowshed, and in the background, a glacier and mountain peak

THE GLORY OF ALASKA

A high, snow-capped mountain peak. The scenic setting of the Alaska Railroad matches the Alps or the Rocky Mountains in splendor

UNCOVERING THE FIRST OF THE COFFINS

These coffins were in a poor state of preservation and yielded only a single cross. The actual labor of excavation was performed by Eskimos



BURIED UNDER AN ANCIENT CHURCH

Pressure due to the earth above had caused the lid of this wooden coffin to collapse. All that remained of its contents was a large, rude cross of wood

Solving Greenland's Historic Mystery

The Medieval Tragedy of White Colonists in the Far North

By Harold J. Shepstone, F.R.G.S.

THE excavations carried out by Dr. Poul Norlund of the National Museum, Copenhagen, at Herjolfsnes, the old Norse settlement of Osterbygd, in the present district of Julianehaab, in Southern Greenland, throw interesting light upon the mysterious fate of the early Norse settlers in this land of the Far North.

In the ancient churchyard at Herjolfsnes, some two hundred valuable relics were found. Many coffins were unearthed, as well as skeletons of the old Vikings in their shrouds, well-preserved articles of clothing, implements, tools, ornaments, and an imposing array of Christian crosses.

Early in the summer of 1921, Dr. Norlund and his party landed in Greenland. After examining the ruins of various Norse settlements they proceeded to Herjolfsnes. At first, inclement weather and the ice hindered their movements. It was not until the beginning of July that the work of excavating was begun. This work continued without a break until August 27th, when attention had to be given to the packing of the many relics that had been found. On account of their age and the delicate nature of many of the finds, particularly the garments, it was most essential that they should be handled carefully.

When they finally arrived at the museum in Copenhagen they had to be examined and classified. This work occupied considerable time, but the result has now been embodied in a bulky volume, *Meddelelser om Gronland (Communications on Greenland)*, which scholars of the future will regard as an important archaeological contribution concerning the fate of those hardy Norsemen who settled in Greenland in the early centuries of the present era.

Herjolfsnes, the scene of the excavations, is a barren, bleak spot, at the foot of Ikigait, an imposing headland, directly on the seashore and destitute of any habitation. The only signs of life the excavators found when they rowed ashore were the wild ravens that circled above them, declaring loudly their displeasure at being disturbed. Herjolfsnes was founded by an Icelander, Herjolf Baardson, who followed Eric the Red to Greenland in about the year 986. It was Eric the Red who discovered and first colonized Greenland, and for a period of 250 years Greenland was an independent state. Then it came under the sway of the King of Norway.

By the Twelfth Century the population of the Greenland colonies could not have numbered less than three thousand. They boasted of their cathedral, monasteries, fourteen churches and 240 large farms. A brisk trade was maintained with Europe until towards the end of the Thirteenth Century when it began to decline, and by the Fifteenth Century it had ceased altogether. It is common knowledge that when Hans Egede, the Danish Lutheran clergyman, went there in 1721, he found only savage, nomadic Eskimos, and from that time up to the present day historians have argued over the fate of the early white settlers.

Sea Uncovers Coffin

The very location of Herjolfsnes was lost. Its site was not rediscovered until 1830 when a missionary visiting the region found an inscribed tombstone used as a capstone over the door of an Eskimo hut. A few years later, as the result of the encroachment of the sea at this spot, a coffin was uncovered, and a Danish official, Ove Kielsen, after a trial digging lasting two days, definitely located the ancient cemetery. Several coffins were found, in addition to a skull with the hair preserved, the light color of which proved definitely that the buried bodies could not be those of Eskimos.

Every time the sea carried away part of the shore, fresh burial remains came to light. This led the Danish Commission, a body responsible for the scientific exploration of Greenland, to open up negotiations with the National Museum in Copenhagen for a technical excavation of the churchyard site.

It was not easy at first to locate the exact site of the churchyard, for the ruins were found to be almost completely overgrown with grass and furtle, only a few stones peeping out here and there. The first task of the excavators was a series of draining operations. This precautionary work proved invaluable in keeping out the water.

It took some days before the yielding layers were reached, but, when the first difficulties had been overcome, the finds came in rapid succession. On July 8th, a wooden cross was unearthed and on July 9th, the first coffin, and on the 11th, the first costume. "The special conditions of the excavations," writes Dr. Norlund, "necessitated the invention of special methods for the exhumation and conserving of the finds, particularly the woven materials. They all lay directly in the earth and would hardly bear touching in their saturated, recently thawed condition. Sometimes the earth could be rinsed away, sometimes it had to be removed with a shovel. In certain cases the uncovering of a costume took a whole day's persistent work. The costume, once uncovered, had to be taken up, and that was an even more difficult task. The wet material was just as heavy as it was frail and could not carry its own weight. It was necessary to unroll sacking under it.

"The next difficulty was the keeping of the costumes. It was the middle of summer and not until the autumn, several months hence, could we expect to be in Copenhagen. There could be no question of any actual conservation on the spot. I tried to clean the earth off the material by rinsing it thoroughly, but it could not be done. I tried drying it slowly, but then the threads burst and crumbled away. The only thing to be done was to keep the material in the same damp condition in which it was found and guard it from contact until it could be dealt with at the museum at Copenhagen.

"We had brought with us three large, tin boxes in which we had intended to deposit the finds for fear the saliferous humidity of the ship's hold should affect them. But, with objects of this kind and in this condition, humidity would be no danger. Apart from the fact that the tin boxes could not hold the very numerous objects, they proved quite unsuitable. A few pieces of cloth kept therein became mildewed.

"The tin boxes being useless, we had to send to the nearest settlement for boards from which we made up cases adapted to the size of the costumes. But how were we to pack them so that they lay firm and would not dry? We had to deal not only with the costumes but with the numerous wooden objects that came to light. It was a serious problem. Grass, heather and seaweed were found to be unsuitable. Our difficulties were fortunately solved in the most satisfactory way. The beds of the numerous little rivers, carrying the melted snow down the mountain-side, were overgrown with thick, quite saturated moss.

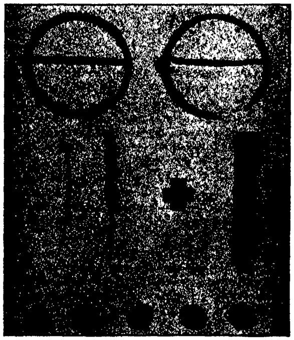
This moss possessed all the properties we required. It was firm, yet soft, and very slow-drying and it was present in almost unlimited quantities. When the objects were temporarily laid on the grass, we covered them with it, and later on we used it as a packing material in the cases, where it lay firmly pressed down on the objects and kept them damp without preventing the access of air. Thanks to this, on unpacking, we found all the objects in exactly the same conditions in which they were laid down, despite the fact that three months had passed since the dispatch of the cases from Herjolfsnes."

Twenty-nine coffins were exhumed, but they did not yield so much as a shroud or even a piece of bone, being simply full of earth. Yet it was in the coffins that the more valuable crosses were found where they had been laid on the breasts of the dead. They are perhaps the most interesting part of the grave furniture, the collection totalling over fifty. Some are elaborately carved and inscribed with the name of the deceased and some religious quotation. In one coffin was found a little, carved stick with the following inscription in the Norse tongue: "This woman, whose name was Gudvig, was laid overboard in the Greenland Sea," the inference being that she died on the way to Greenland, was buried at sea, and on arrival of the vessel at Herjolfsnes the little stick was carved in memory of her, placed in a coffin, and buried in the churchyard.

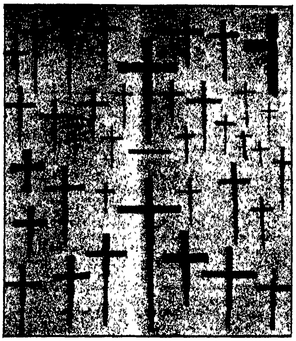
Coffin-burial a Luxury

The coffins were mainly of spruce, deal, red pine or larch and consisted of drift and imported timber. Only a single specimen was found to be of native growth, namely, of Juniper wood, a tree which still flourishes in Southern Greenland, although inclined to be stunted in growth. Some of the coffins were joined by wodden nails, others by whalebone fiber.

The distribution of the coffins and shrouds would indicate that coffin-burial was preferred by those who could afford it. For the most part the coffins were found closely packed around the walls of the church where the most coveted burial-places were. In the out-of-the-way corners of the churchyard there were no coffins, but here some of the best-preserved shrouds were found. These shrouds consisted of genuine articles of clothing, sometimes complete, sometimes mere fragments, but rarely so fragmentary that their use could not be determined. There were dresses, hose, hoods and caps. Evidently the clothing was not made for the dead, but had been worn by them when still alive. Hence they bear marks of wear, and indeed, many of them are quite threadbare and patched with big patches. Mending was done by means of patching, darning as a means of repairing evidently being unknown. All the costumes are of woven material and from tests made, they would appear to be entirely of sheep's wool.


CRUDE ORNAMENTS RECOVERED

Two brass brooches, copper pins, a pendant cross of bone, a wooden peg and a man's sleeve buttons

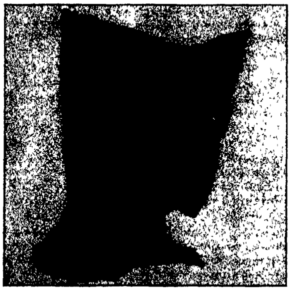

A COLLECTION OF RECOVERED CROSSES

Altogether, fifty-eight of these wooden crosses, some of them bearing runic inscriptions, were dug up

It was only in the shrouds that any skeletons were found and some twenty-five of these were brought to Copenhagen. They were in a poor and exceedingly fragmentary condition and at first appeared to be hopelessly damaged and devoid of any value. Thanks to the skill and initiative of Dr. C. C. Hansen, Professor of Anatomy at the museum, they were cleansed, sorted and subjected to minute microscopical examination with the most interesting results.

The task of conserving the relics was a protracted one. It also proved troublesome, and was inclined sometimes to be rather unpleasant. The wooden objects were treated with alum or glycerine. The various articles of clothing were first immersed in water, lying on the sacking on which they had been taken up. Here they remained for some days in order to dissolve the various foreign substances that had become entangled among the threads, such as root-fibers, and especially deposits from the decayed body clinging to the material.

After the rinsing was finished the stuff was slowly dried, and was then subjected to a kind of massage cure, being laid on a table and treated with the fingertips to remove all foreign particles. This was the most important part of the conservation work, and also the most troublesome part. But when it was accomplished, the material had regained its old elasticity, and, to an astonishing degree, its original strength. A backing of tulle was affixed to the more dilapidated parts, whereupon all the material was treated with a beticol preparation.


AN ANCIENT HOOD

Skulls of both men and women were found inside hoods made of coarsely woven material

The style and cut of many of the costumes would indicate that they are of the Fourteenth and Fifteenth Centuries, clearly showing that the Norsemen were in communication with Europe up to that time. There is certainly geographical and geological evidence to show that it was at this period that a fatal change of climate occurred in these northern latitudes. Whereas Herjolfsnes and the adjoining fjords had been free of ice all through the summer, they suddenly became blocked virtually all through the year, thus rendering navigation exceedingly precarious if not impossible.

It was at this period, too, that a gradual decline of shipping in Norway took place. This decline of shipping, coupled with the unexpected presence of ice in midsummer, no doubt meant that attempts to keep in touch with the settlements were gradually given up and then ceased altogether.

When the Norsemen settled in Greenland there were no Eskimos there, although they found remains of Eskimo dwellings. The latter had retreated northward following the ice on which they hunted seals, their principal item of food. Much later when the ice came south, they poured down upon the colonists and there are records of encounters between them.

Ravaged by Disease and Malnutrition

Being cut off from Europe, on which they had learned to depend for many essentials to their existence, and being called upon to face a terribly rigorous and hard climate, the colonists gradually deteriorated in physique. This is evidenced by an examination of the skeletons. They were short of stature, especially the women. Constitutionally they were a weak and declining race, due no doubt to a long period of undernourishment.

Not only were they small of stature but, from an examination of the skeletons, many of them had diseases involving physical deformities such as the weakening of one arm, or one leg, and even in some cases the trunk of the body. There are also distinct traces of tuberculosis of the vertebral column.

Against the Eskimos, so brilliantly adapted to the arctic conditions, the physically weakened Norsemen could not hold out and their doom was sealed by the encroaching Greenland ice.

THREE GENERATIONS

A man's short-sleeved dress of heavy material, a child's dress and that of an older girl

Our Point of View

The Last Word on the *Shenandoah*

AFTER a most searching investigation into the loss of the *Shenandoah*, the court has issued a report which we think should carry conviction Anyone who followed the long-drawn-out hearing must have shared our conviction that no partiality was shown and that the court was honestly striving to get at the absolute facts. In the first place, the court places no blame upon any of the personnel for the loss of the *Shenandoah*. It was clearly established that the naval authorities at Washington, so far from forcing the hand of the late commander, Landsdowne, listened to his objections against making the trip earlier in the season, as first proposed, and left it to his final decision as to when it would be desirable to start on the trip to the west. It was clearly established that not only the captain but all of the officers and crew, entered upon this cruise not only free from apprehension, but with the enthusiasm which is characteristic of the flying personnel. The disgusting newspaper sensationalism (we can call it nothing less), which did not hesitate to invade the privacy of a young widow within a few hours after the death of her husband and endeavor to show that there was coercion on the part of the Government, was proved to be sensationalism pure and simple without a basis of fact for its charges.

It will be no surprise to those who followed the evidence that the court exonerates the personnel from any responsibility for the disaster The loss of the *Shenandoah* must be considered "as part of the *price that must inevitably be paid in the development* of any new and hazardous art" As we suggested in an earlier issue, it was the entrance of the ship into a violent line storm with its ascending and descending currents which destroyed her. "The final destruction of the ship was due primarily to large, unbalanced, external, aerodynamic forces, arising from high-velocity currents."

Although the court holds that none of the structural changes in the ship contributed to the accident, it gives a measure of endorsement to the claim made by Captain Heinen that the reduction in the number of gas valves was the direct cause of the accident. A review of the testimony on this point, says the report, justifies the opinion that "gas pressure due to altitude and rate of rise may well have reached values sufficiently high to produce damage to the structure" We believe that, though excessive gas pressure and aerodynamic forces had their share in the destruction of the ship, it will never be possible to determine the relative destructive effect of each

Billion-Dollar Dividends of Research

IN a recent address, Secretary Hoover pointed out to the American nation that our material civilization rests squarely on the sub-foundation of abstract research in pure science When you telephone, when you drive your car, when you wash with scientifically made soap or eat scientifically balanced bread, do you think of the ultimate source of the scientific truths that made them possible? Just as engineering, industry, medicine and all the important arts of today rest on fundamental scientific principles, doggedly worked out in the past, so those of the future will depend on the research of today.

Professor R. A Millikan recently pointed out that our entire knowledge of mechanics rests on the abstract research of one man, the immortal Galileo. In our own day one man's research resulted in the discovery of the three-element vacuum tube, and radio became possible—a billion-dollar by-product of a mere laboratory effort. Think of it!

More of the current dividends of industry must go back into the business, enriching the mother lode of pure science and abstract research from which applied science may later on be dug. And the scientist must not forget that, unless he take the public into his confidence and write about his research in the language of the ordinary mortal, thus gaining the sympathy of the layman, who in the last analysis foots the bill, his beloved science will always be in danger of such attacks as that which occurred last summer in Tennessee.

Elimination of Waste

Among the many investigations that are afoot, and their name is legion, there is none so rich with promise of benefit, industrial, financial, aye, and social, too, as that which is being carried on under our indefatigable Secretary of Commerce, Herbert Hoover. We refer to the nationwide campaign to eliminate waste. Already the first fruits have been gathered. There has been an increase in railroad efficiency; larger and faster trains carry freight at a markedly lower cost of fuel per ton-mile. By improving inland waterways, bulky goods are being attracted in the midwest area to the cheaper waterborne traffic. There is a fuller utilization of our water resources for irrigation, flood control and power. There is an ever-increasing elimination of waste, by closing innumerable small power plants and concentrating in highly efficient units in a few large stations. Let us never forget that failure to use great natural resources is waste on a gigantic scale. Neglect of water power means an equivalent consumption of coal, and coal thus used is coal wasted.

Physicians and Philanthropy

WHATEVER may be said against the superior social standing, which is still accorded in many European countries to the professions as distinguished from the trades, the distinction, where it exists, is based upon a historical fact of great ethical interest. Centuries ago, when learning was confined almost exclusively to the doctor, the priest and the lawyer, and the great mass of the people, from lordly baron down to poorest serf, were absolutely unlettered, it is a well-attested fact that these gentlemen were supposed to give and very largely did give their services gratis, their remuneration depending upon the means and good-will of their clients.

That this high, ethical standard is by no means dead in this money-making age is proved by certain statistics which have recently been made public by a director of the National Endowment Fund for the Physicians' Home for Aged Physicians and Surgeons and their Families. It seems that the physicians and surgeons in New York give the public annually, free of charge, services which are estimated to be worth at least fifteen million dollars; while the country at large receives free services worth one hundred and thirty-five million dollars. This statement is based only on what is known as "free hospital days" and it takes no note of visits to patients who can not, or will not, pay for such services. The estimate was arrived at from returns from 107 out of 140 medical and surgical serving institutions in which, during twelve months, New York medical men gave 5,020,502 "free hospital days" which at three dollars, give us a total of $15,061,506.

We confess that these figures are amazing. They assist in answering the question as to why so many physicians make barely enough for a decent existence; why the majority (so the director tells us) die without estate; and why many become public charges because of financial difficulties. So when anyone of you finds himself the subject of exorbitant medical charges (and that such charges are too frequently made is attested and condemned, now and then, by leading physicians) bear in mind the enormous amount of charitable work mentioned above, and do not allow the extortions of the few to cloud the honor which belongs to the great body of medical men as a whole

The House Naval Bill

THE discussion of the House Naval Bill by the Naval Commission has revealed a sharp division of opinion among the ranking officers of the Navy, particularly as to the future policy in regard to the construction of dirigibles. Secretary Wilbur and Admiral Jones are opposed to the construction of a new dirigible to take the place of the *Shenandoah;* and they are in favor of closing down the activities of the naval station at Lakehurst, New Jersey They recommend that the sum appropriated for the maintenance of Lakehurst station be reduced from $1,880,000 to $130,000 *In other words, the magnificent* hangar will be practically put out of commission and the *Los Angeles* with it

We believe that the closing of the Lakehurst station (for it practically amounts to that) would be a serious mistake, defeating the very object of economy at which it aims. The large sums of money which have been expended on lighter-than-air craft and the acquired experience in designing and operation, constitute an asset whose value will very largely be lost if the Navy closes and locks the gate on future development. The Aeronautical Bureau wishes to embody its experience in a new and larger ship and suggests that this is the time to carry forward our experimental work with vigor. To close the Lakehurst station and abandon all work on airships would be considered throughout the world as a confession of failure upon the part of our Navy.

If we object to the aeronautical policy advocated by the Committee, we are, on the other hand, heartily in sympathy with its proposal to secure economy by placing some of our battleships out of full commission and maintaining them with skeleton crews. "With respect to putting some of our vessels in reserve," says the report, "it should be pointed out that Great Britain has but thirteen of her eighteen capital ships in full commission. We have had eighteen until recently, when three were detached and decommissioned for modernization." The difference between keeping eighteen and a dozen modern battleships in full commission would represent a large saving of funds which could be expended where they are desperately needed—namely, in the construction of large cruisers and fast scouts, in which our Navy has a lamentable deficiency.

Star Clusters

There Is a Close Relation Between the Brightness and Spectral Types of Their Component Stars

By Henry Norris Russell, Ph.D.

Professor of Astronomy at Princeton University Research Associate, Mt Wilson Observatory, California

THE stars are decidedly gregarious; although they are scattered all over the vault of heaven, they congregate here and there into groups and clusters, some of which are conspicuous enough to have received names in antiquity which are still in use.

The best known of all these clusters is the Pleiades—which from its compact character, and the brightness of its constituent stars, cannot fail to attract attention. The more straggling cluster of the Hyades—also in the constellation Taurus, was likewise known and named in Greek times. The smaller and denser cluster in Cancer which appears to the eye as a hazy spot of light, but shows its separate stars with a field-glass, bears the Latin name Praesepe, and another loose cluster, farther east in the skies, has been raised to the dignity of a constellation, under the name of Coma Berenices—commemorating the beauty of the hair of some fair lady of classic days.

Galactic or Open Clusters

These four conspicuous groups are examples of a type which finds hundreds of representations among telescopic objects—the so-called "open clusters." This name is given them in antithesis to the far richer and more condensed "globular clusters"—from which they differ in the smaller number and more open array of their stars. In their situation in the heavens, too, they are unlike the others, being for the most part in the Milky Way—for which reason they are sometimes called "galactic clusters"—while the globular clusters avoid this region of the sky.

They differ, too, from the globular clusters' in being much nearer. While the nearest of the latter is twenty thousand light-years away, the nearest open cluster—the Hyades—lies at a distance of only 140 light-years—less than one percent as far away. Several of the other clusters are real enough to show definite proper motions—all the cluster-stars moving together in space like a flock of birds in the sky—while the globular clusters are so remote that their motions, though really very rapid, appear imperceptible.

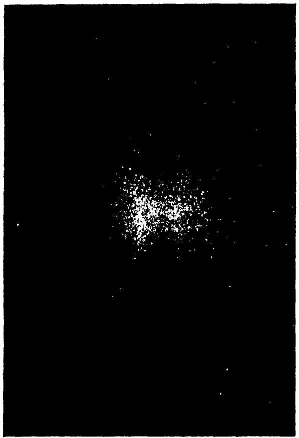
Measuring Their Distances

By indirect methods the distances of all the star clusters have been accurately measured by Dr. Harlow Shapley, taking advantage whenever possible of the luminosity-period relation that obtains in the Cepheid variables. Apparent diameter of the cluster and its distance may be correlated on the assumption that globular clusters are of the same order of linear dimension.

Where no Cepheid variables are present another method is employed. It is assumed that the typical giant stars of the cluster have about the same absolute magnitude, and that this holds good for all the clusters. Therefore the apparent magnitudes of the twenty-five brightest stars of the cluster in question are determined, and since their absolute magnitudes are known, as mentioned above, their distances may be easily deduced by comparatively simple mathematical formulae.

It is not surprising, therefore, that individual stars of the open clusters appear to us much brighter than any in the globular clusters. This makes it possible to study them individually—for example, to photograph their spectra.

In the brighter clusters, it has been known for many years that the relation between the brightness and spectral type of the stars is very close. The brightest stars of the cluster are white, the fainter ones, yellowish and the faintest are yellow, or even reddish. This is exactly the relation which is found among the majority of the stars whose distances and real brightness are known, and is characteristic of the "main sequence" of stars of which we spoke a few months ago.



Brown Brothers

A GLOBULAR STAR CLUSTER

Its diameter is at least 1,000,000,000,000,000 miles. Our sun may be thought of as lying near the center of a cluster such as this. Such clusters are not compact

In this sequence the average brightness or "absolute magnitude" of the stars varies rapidly with the spectral type—stars of class A, like Sirius—averaging about thirty times as bright as the sun—those of class G—like the sun—being of about the sun's brightness, and so on.

In the Hyades cluster, where the distance can be found accurately by other means, exactly the same relation between absolute magnitude and spectral type holds true. In the other clusters, for which the distance has not been directly measured, the relative brightness of the whiter and redder stars follows the same law; but the apparent brightness of the stars, as we see them differs widely. It is natural and reasonable to attribute these differences to differences of distance from one cluster to another—the stars in the remoter clusters appearing fainter. In this way it is found that the Pleiades and Coma Berenices are at distances of about 300 or 350 light-years and the Praesepe group a little farther off, perhaps 450 light-years.

A systematic study of the fainter clusters has been made—indeed is still under way—by Dr Trumpler of the Lick Observatory. Working with specially designed spectroscopes of great light-gathering power he has determined the spectral types of the stars in more than fifty clusters. In every case but one, the same steady gradation of color with brightness presents itself and it is evident that most of the cluster stars belong to the main sequence.

In rather less than half the clusters, yellow or red giant stars, about as bright as the white stars of class A, are also present—for example in Praesepe, Coma Berenices and the Hyades. In the rest, for example in the Pleiades, all the stars belong to the main sequence.

No Strict Uniformity

A few scattered stars which do not conform to either of these groups are doubtless interlopers—stars which do not belong to the cluster at all, but lie in front of it or behind it. For some of the near clusters, this suspicion is turned to proof, when it is found that the suspected stars are moving in different directions, or at different rates, from the members of the cluster.

In the one aberrant case—a loose cluster of relatively few stars—there is no recognizable relation between brightness and spectrum, and it is probable that this is a mere chance agglomeration of unrelated stars.

For all the other clusters, the grouping evidently corresponds to a real association of the stars in space, and the distance of the cluster can be found from the difference between the apparent and real brightness of the stars of a given spectral type.

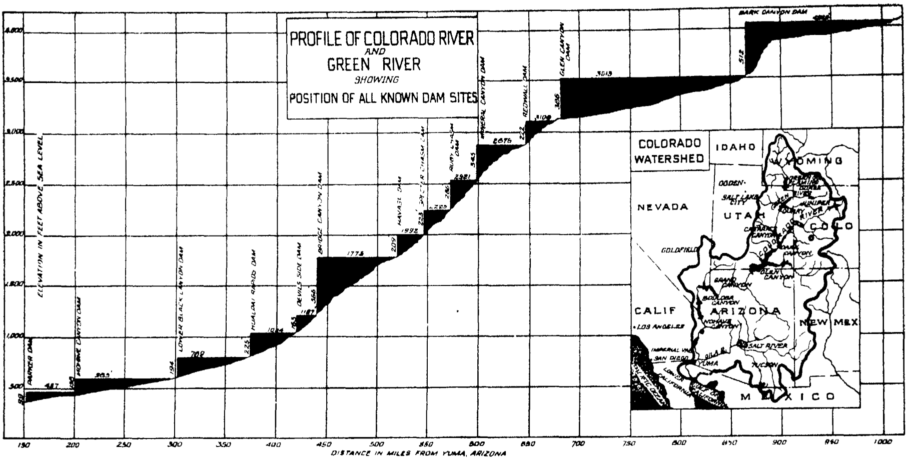
Clusters in Evolution

Dr Trümpler thus finds that the four bright clusters which have already been named are the nearest. The others have distances ranging up to 16,000 light-years—most of them lying between 1,500 and 6,000 light-years. This shows that they lie well out in the Milky Way, although the remotest of them is nearer than the nearest of the globular clusters.

Why some of these clusters should contain red or yellow giant stars and others none demands explanation, and this demand is intensified by Dr. Trumpler's discovery that whenever the cluster contains stars of class B—the brightest and hottest of all—the redder giants are absent. He makes the reasonable suggestion that this is a matter depending on the age of the cluster.

If—as is now very generally believed—the stars start their careers as red giants, develop first into stars of class A or B and then fade gradually into dwarf stars, only the relatively young clusters should contain giant stars of low temperature. In the course of ages, these red stars should gradually grow yellow and then white, finding no successors to take their places, and thus a group like the Hyades would turn ultimately into one which roughly resembles the Pleiades.

The fact that the B-stars, when present at all, are much brighter than any others—averaging more than a thousand times as bright as the sun, is not, however, fully explained. But the interpretation of this may come with a continuation of the studies which are now in progress.



The Subjugation of the Colorado

Substituting Power, Light and Fertile Lands for Disastrous Flood Waters

By Guy Elliot Mitchell

THE great Colorado River of the west is no longer a mystery, an unknown danger. It has given up all of its secrets to engineering and scientific exploration and, even now, definite plans have been formulated to prevent its disastrous floods, to harness its vast power and to spread its huge volume of fertilizing, irrigating waters over millions of desert acres. The complete subjugation of the Colorado is an engineering undertaking of stupendous magnitude—one, not of millions but of hundreds of millions of dollars of cost

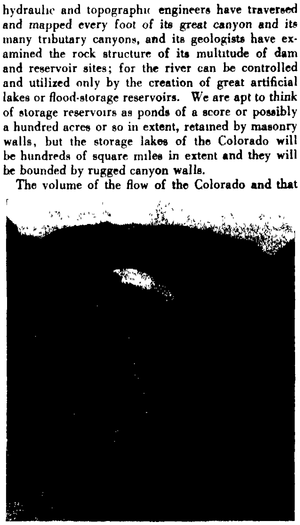
The Monster Will Be Tamed

The Colorado has its source in the high mountains of the Continental Divide. Its waters drop some 14,000 feet in their 1,500-mile course to the sea. Every workable horsepower in that great fall is to be utilized as needed—and, after this energy has been harnessed, the same waters, gathered from a watershed of 244,000 square miles, will be led out to irrigate millions of acres of thirsty, desert lands and there to produce crops of fabulous magnitude

If there is poetry in engineering, surely the Colorado is a fascinating theme for contemplation. A wild and cruel monster, a giant of destruction to human life and property, its evil tendencies may all be corrected; it may bring staple foods and luscious fruits to millions of people, it may turn the wheels of a thousand industries, and though now a region of almost utter inaccessibility, a fact not very generally realized, it may become a place of lake and canyon splendor surpassing perhaps anything in the world, to be visited with ease and comfort.

Looking somewhat ahead of the present interest in the Colorado, the United States Geological Survey has for many years been making a close study of the river and its great watershed. The Survey's hydraulic and topographic engineers have traversed and mapped every foot of its great canyon and its many tributary canyons, and its geologists have examined the rock structure of its multitude of dam and reservoir sites; for the river can be controlled and utilized only by the creation of great artificial lakes or flood-storage reservoirs. We are apt to think of storage reservoirs as ponds of a score or possibly a hundred acres or so in extent, retained by masonry walls, but the storage lakes of the Colorado will be hundreds of square miles in extent and they will be bounded by rugged canyon walls.

The volume of the flow of the Colorado and that of its tributaries has been measured and plotted by the Geological Survey engineers during a period of over twenty years. This close scrutiny of the behavior of the river, of its range in flow from a comparative trickle of 3,000 cubic feet of water per second to wild floods of over 200,000 second-feet, and the examination of inaccessible dam sites, culminated two years ago in the voyage by engineers and geologists through the 200 most dangerous miles of the Grand Canyon itself



RAINBOW NATURAL BRIDGE
Three hundred feet high, chiselled out of one solid mass of rock by the age-long action of the elements

And now comes the result of this labor of magnitude, analyzed and presented in a government engineering report—a definite plan for the complete subjugation and utilization of the river. It is a project to construct 13 great dams and reservoirs and create hundreds of miles of artificial lakes, whereby all the floods of the Colorado will become only historic; since they will be converted into a great resource by the utilization of all the water for power and irrigation.

One Comprehensive Plan Essential

E. C. LaRue, the author of the Colorado River report and plan, is a hydraulic engineer of the Geological Survey, and throughout the southwest you may often hear him referred to as the "father of the Colorado." He has known the river for half a lifetime; he has made hundreds of miles of boat trips through its wild and treacherous canyon reaches, charged with the responsibility of selecting all possible dam sites and supervising their survey.

But even in this report, the Geological Survey is not presuming to promote any particular power or irrigation project. It is making available the mass of information needed for outlining a feasible scheme for the full development of the river and especially for an orderly and wise planning. The river must be developed as a single undertaking, piecemeal it is

true, but according to a general plan; and no single or initial project must be permitted which will ruin or detract from the later and greater possible ultimate development. In order that this may be accomplished, there must be government regulation of the engineering phases of the work.

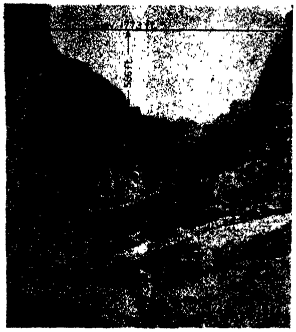
The beginning in construction will doubtless be to prevent flood damage. There is urgent need for the building of a dam to protect the hundred or more million dollars invested along the lower reaches of the river in the Imperial Valley and elsewhere. The recurrence of any one of the big floods of the Colorado would wipe out this property and perhaps cause great loss of life—and it may come next year, or in any year. It is also probable that a dam for the development of power will be built at an early date. But these or any other dams should be built as part of the whole, big adventure.

In developing the water resources of the United States, Mr. La Rue states, the haphazard policy under which our cities have been laid out has been followed. In the development of our important rivers, he fails to find an instance in which a comprehensive plan of development was prepared in advance of construction. Engineers have been sent into the field to locate sites where water might be stored or power developed at a minimum cost. Almost without exception the projects for immediate development have been selected with little regard for future developments.

Its Value for Irrigation and Horsepower

Summarized, the thirteen-dam-plan would make available 3,383 feet of fall in the 860 miles of the Colorado below its juncture with its principal confluent, Green River, for the development of power, and a maximum of 42,000,000 acre-feet of storage capacity for the control of floods, the equalization of flow and the storage of silt. Including full development in the upper basin, it would make possible the irrigation of nearly 6,000,000 acres and the generation of 3,420,000 continuous horsepower Under an annual load factor of 60 percent the aggregate installed capacity of the plants would be 5,743,000 horsepower. It would also provide a domestic water supply for a population of 10 to 15 million in urban communities in the southwest.

A brief glance at two or three of the dam-site and reservoir projects included in Mr. La Rue's plan will be of interest. The Ouray headwater reservoir site is on the Green River in Northeastern Utah. With a moderate sized dam, 170 feet high, a reservoir would be formed with a capacity of 8,000,000 acre-feet* This reservoir would regulate the flow of the Green River for adjacent irrigation and power; but it would also be beneficial to irrigation and power on the Lower Colorado. The stored water, as released, might eventually pass through power houses with an aggregate head of more than 3,400 feet, and the flood flow of the lower river would be materially reduced. If the flow of the Green River were thus regulated, less storage capacity would be required at all hydraulic structures built on the lower river, whether operated in the interests of flood control, irrigation or power development, a fact which appears to show the wisdom of a plan involving up-stream storage.



BRIDGE CANYON DAM SITE

The side walls are of granite The dam would develop over 600,000 continuous horsepower

The lower end of Glen Canyon reservoir site, one of Engineer La Rue's thirteen, is located just above Lees Ferry. A dam 386 feet high, cementing together the precipitate Jurassic sandstone walls of this part of the Grand Canyon, would back the water up the Colorado, forming a narrow lake over 175 miles long, and would store 8,000,000 acre-feet. This would remove the flood menace on the river below, and would reduce the cost, by millions of dollars, of all dams subsequently built below this canyon. There are ten such dam sites below,, where a total head of 2,523 feet may be utilized for power development. At present, without storage, the total power capacity of these ten sites is 1,758,000 horsepower; but with storage in Glen Canyon reservoir their capacity would be increased to 4,345,000 horsepower. That the construction of this single dam is a stupendous undertaking is seen from the statement that to complete the underwater foundation work on the dam it would be necessary, in the long interval between successive annual floods, to pour between 5,000 and 10,000 cubic yards of concrete a day.

Glen Canyon is a remarkable dam site. By about doubling the height of the proposed dam, the reservoir thus formed would store more than twice the entire annual flow of the Colorado. Immediately above the head of Glen Canyon reservoir would rise the dam of the Dark Canyon reservoir 148 miles long, which would carry the chain of reservoirs up to over a hundred miles beyond the confluence of the Green River with the Colorado River Another great lake would be the Mohave reservoir at the extreme lower end of the Grand Canyon, which would store 10,400,000 acre-feet of water and form a lake 100 miles long and five to eight miles wide. Another remarkable site is at Bridge Canyon where a dam 566 feet high, between granite walls, would take the water out of the river on the 1,773-foot level—above sea level—for irrigation purposes, and would develop over 600,000 continuous horsepower.

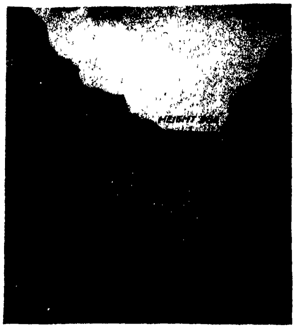
Will Provide Scenic Beauty

There must be a further word touching on the scenic development that would result from the adoption of La Rue's suggested plan. From the town of Parker, down in Arizona, all the way up to the confluence of the Colorado with the Green River in Utah, the thirteen reservoirs would form a chain of lakes of practically unbroken continuity. These lakes would vary in width from narrow fjord-like bodies of water, deep down below precipitate walls and cliffs thousands of feet high, to others several miles across.

Among other present inaccessible wonders, the Rainbow Natural Bridge would be brought to within a mile of the shore of the Glen Canyon reservoir-lake This graceful, natural arch of sandstone is high enough to span the dome of the Capitol Building at Washington and surpasses in size and symmetry any other known natural bridge Mr. La Rue, although a hard-headed engineer, ventures in his report the belief that, after the completion of automobile highways leading to the Glen Canyon Lake, the tourists to this section alone would number hundreds of thousands annually.

COLORADO RIVER BELOW GLEN CANYON DAM

The dam would develop 334,000 continuous horsepower. The water is carried through a tunnel to discharge into penstocks, thence down to the power house (left). The overflow discharges through a tunnel (right)



GLEN CANYON DAM SITE

This dam, 386 feet high, would form a lake, extending for 175 miles up the Canyon

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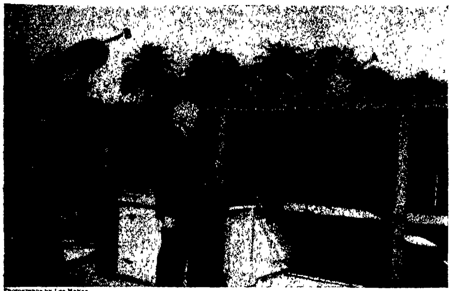
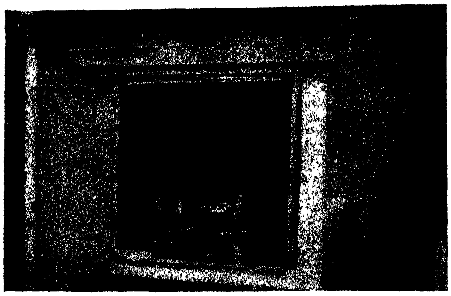
* Acre-foot equals one acre of water one foot deep.



Photographs by Lee [illegible]

DR MOORE AND HIS AIR GATHERER

A and B are wind-vanes which control the intake and outflow apparatus



THE AIR WASHING AND COOLING APPARATUS

Here the air is cooled as much as thirty degrees on a hot summer's day

Cooling Your House in Summer

How a Former Chief of the Weather Bureau Solved the Problem of Keeping the Air in His Home Cool in Hot Weather and Moist in Winter

DR. WILLIS L. MOORE, for twenty years chief of the United States Weather Bureau, former President of the National Geographic Society, and founder of the *National Geographic Magazine*, has found a practical way to maintain the air in his home at Pasadena, California, both cool in summer and hygienically moist in winter.

In summer, the Professor takes in air from a large scoop on the roof, washes it, cools it in a simple apparatus and then passes it all through his house by means of ducts. In winter, he maintains the relative humidity of the air at seventy percent, where it ought to be, by means of a special humidifying heater.

The summer apparatus consists of air-scoops on the house roof, an air washer and air cooler, a fan and eight-inch conduits leading to the various rooms, also registers for controlling the inflow. With this simple equipment, Dr. Moore has found that the house may be closed as tight as a drum, yet in the extreme heat of summer the temperature will not exceed 80 degrees.

Windows Never Opened

In the left-hand illustration of the two shown above, the detail of one side of this four-sided air-scoop may be discerned. You are looking into three separate ducts, at the level of Dr. Moore's hand. Imagine several more of these ducts radiating from a center, in all directions of the compass, so that some of them will always catch the breeze. At the center there is a vertical, metal cylinder with one-fourth of its circumference cut away, thus leaving an opening into which the wind collected by the scoop ducts may blow. This opening is always kept directed towards the proper scoops by means of a wind vane which shows at A.

The air rushes into the scoops and since they are narrower at the center, it gains velocity. This forces it out of the end of the cylinder and through the washing, cooling and moistening vats which are contained in the box just behind Dr. Moore.

In the illustration on the right, above, the contents of this box are shown. The fibrous, cloth-covered cones, which wash and cool the air, are shown projecting out of the water. In passing through this part of the equipment, the air, when its temperature is high, is cooled some 30 degrees

In the same box an electric fan is shown. This fan may be used to force the washed and cooled air down through a number of eight-inch ducts to the ceilings of the rooms, where its inflow may be controlled by registers. Thus, with this fan, all of the air may be changed within eight minutes. However, it is rarely that this fan is needed. Careful tests have shown that without the fan a wind blowing at the rate of only three miles an hour will completely change the air in the house within fifty minutes.

THE HUMIDIFYING APPARATUS, USED IN WINTER

The heat is turned on by means of valve B. Valves A, A, are for controlling the amount of humidity

In each room there are two registers on the ceiling, one being the inflow register, the other the outflow register The latter lead to exhaust flues on the roof One of these flues, equipped with a wind-vane which keeps it pointed away from the wind in order to provide suction, is shown at B, in the left-hand illustration, above.

Ordinarily, the circulation of the air within the rooms is almost imperceptibly gentle, yet its velocity may be measured by means of little, spinning air-meters placed on each inflow register.

Practically all of this equipment was invented by Professor Moore. His house is equipped with double windows, and so efficient is the air-circulating apparatus that in the period—almost two years—since his house was completed *not a single window has been opened*. There is no need to open them. Moreover, double windows are a discouragement to burglars.

Between the double windows and between the double walls of the house there is also a constant air circulation. Every room in the house has its own thermometer and hygrometer and these tell at a glance, the temperature and amount of moisture in the air.

The humidifying apparatus for winter use consists of a heater, shown in the illustration in the middle of the page. This heater has four units. Water is let into each unit separately, by means of a valve. A float maintains this water at constant level. By manipulating the valves the desired percentage of relative humidity in the house may be controlled. In practice, in Dr. Moore's house, one, or at most, two of the units provide enough moisture to keep the air at 70 percent relative humidity.

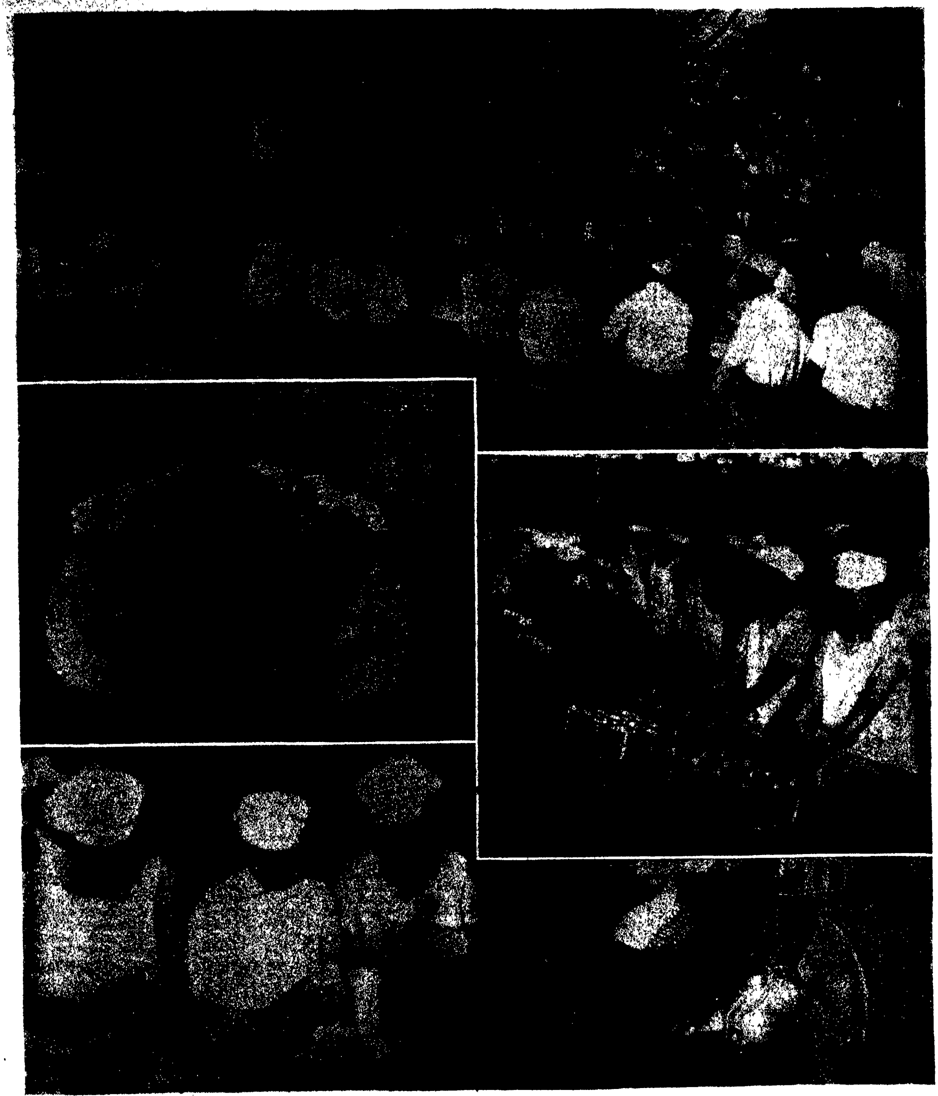
Hot Air Is Thirsty

Few people know the effect on the contained moisture when we warm our air. For each 18 degrees that we heat it, air *doubles* its capacity for holding moisture. What, then, is the corollary of this statement? It means that since we do not usually give our air a chance to take up this needed moisture, it goes without.

No, it does not entirely go without, it abstracts all the moisture it can get from our woodwork and our furniture, which dry up, shrink and crack. Far worse, it takes moisture from *us!*

As was recently pointed out in the *Journal of the American Medical Association*, when we take cold air from out-of-doors at freezing temperature and at a relative humidity of 80 percent and heat it to 70 degrees, we thereby reduce its relative humidity to only 20 percent. We then live in this air and so we become kiln-dried, along with the woodwork. Office buildings, heated to nearly 80 degrees, often have a relative humidity of as low as 15 percent.

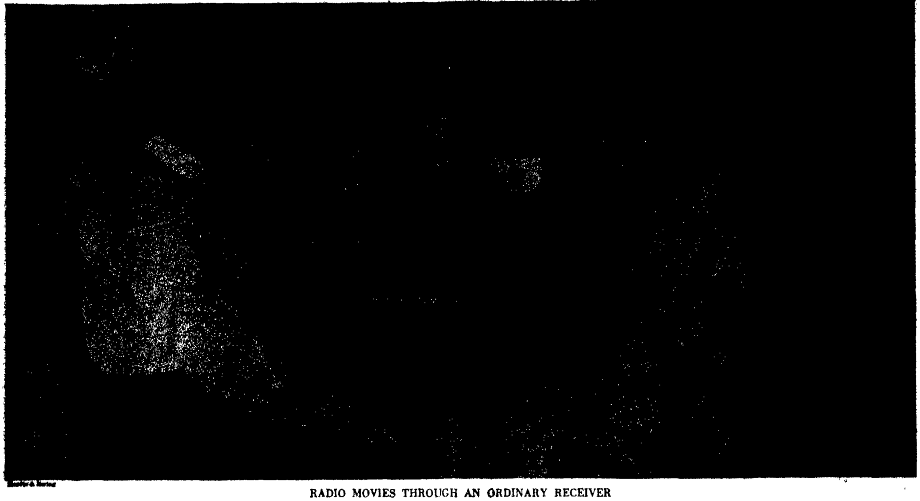
Thus we get the hot-house habit. We become hypersensitive, afraid of every chill and every little draft. We also get colds, grippe, even pneumonia, because the dry, thirsty air of our houses blots up the moisture of our throat passages and reduces their natural resistance to infections.



Edgeworth Studio, Honolulu, Hawaii

Scenes in a Pineapple Cannery in Hawaii

TOP: The employees of a big pineapple cannery represent all races. They are shown here enjoying a Christmas dinner in their cafeteria. LEFT: Hawaiian, Filipino, Chinese, Japanese, Korean and Portuguese girls work side by side. Here they are removing skin specks from the shredded pineapple. RIGHT: Girls sorting slices of pineapple. LOWER: Cutting off the edges of the pineapple skins by hand. The workers wear rubber gloves to insure cleanliness.



Harris & Ewing

RADIO MOVIES THROUGH AN ORDINARY RECEIVER

C. Francis Jenkins, of Washington, demonstrating his radio motion picture receiver for use in homes. A miniature screen is placed on the wall, and a distant scene in action is reproduced. This shows the picture of a girl dancing at the transmitting station, detected by an ordinary broadcast receiver

Seeing Around the World by Radio

The Development of a New Combination Photo-electric Cell and Vacuum Tube Has Created an "Eye" for Wireless

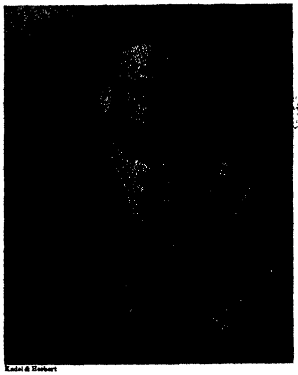
By Orrin E. Dunlap, Jr.

RESEARCH engineers are making rapid progress in developing an "eye" for broadcasting, so that television, or seeing distant scenes by radio will be as common as tuning in music. It has been learned upon good authority that television apparatus in simple form will be on the public market just as soon as all phases of the system are protected by patents.

Scenes Sent Through Space

When the radio optic, and its associated instruments, is released to supplement broadcast service, it will work in conjunction with the microphone, the former picking up light waves, so that they can be transformed into electricity and radio waves, and the latter doing likewise with sound. Then the radio announcer will snap a switch connecting the mechanical eye and ear with the transmitter and all scenes and sounds within range will be sent through space to millions of homes. For example, the eye-ear device might be placed in front of Niagara to record the thunder of water, camera the spray cloud and forward the picture along with the roar to firesides and schools throughout the nation, and some day to a world-wide audience.

It will all be true to life and nature, is the prediction of radio men. Today it may seem far-fetched, but so did broadcasting six years ago. Those in touch with the research laboratories know that television will be a reality. Today there are approximately 1,000 broadcasters in the world; and when they are equipped with "eyes," the scenes of the earth, now thousands of miles apart—from the Orient to America, from New York to Moscow and from the North to the South Pole—will be separated by just a few marks on the scale of a simple tuning device.



Kadel & Herbert

INVENTOR AND HIS RADIO "EYE"

V K Zworykin, research engineer, who has produced the combination photo-electric cell and vacuum tube, which experts say is the basis of television. Compare the new tube with a modern receiving tube, held in his left hand

When a broadcasting station goes on the air there is a carrier current or steady stream of energy sent through the ether. It serves as a wire or pathway through space over which the music and words take flight. When the microphone is switched into the circuit all sounds within its range are picked up and their vibrations in the microphone cause corresponding fluctuations in the electrical circuit connected to the broadcast transmitter. Thus, the carrier wave is modulated accordingly, that is, instead of it being a constant flow of electricity it is shaped to correspond with the tones of the music or of the voice.

Photo-electric Cell the Important Link

The main problem has been to produce a device which will treat a shadow as the microphone does a whisper. The photo-electric cell, employed in various processes, is apparently the important link in the chain of developments, which will make television and radio movies possible. The fundamentals of the photo-electric cell were discovered by Hallwachs, a German physicist. The principle is based upon the fact that certain metals give off electrons when their surfaces are illuminated. Generally, an alkali metal is employed, such as potassium, sodium, caesium, rubidium or lithium.

This cell has been combined, by V. K. Zworykin, a physicist of the Westinghouse Electric Research Laboratories, with the radio vacuum-tube amplifier to form a new step in science. It resembles the ordinary vacuum-tube detector and amplifier used in broadcast receivers, but variations of light falling on this device instantly become variations of electrical current and are amplified thousands of times. The current, which the light waves create as they strike the tube, is amplified by the tube itself.

The photo-electric cell is built into the tube, one end of which is coated on the inside with potassium, or an alkaline metal which throws off showers of electrons when light falls upon it. This electron stream is an electric current. The electron flow is feeble if the light is weak, heavy if the light is intense. Thus the variation in light governs the strength of the electron shower. In order to prevent the light from the filament falling on the sensitive film of alkaline metal, metal shields are used and the filament is operated at a temperature below visual emission.

Smoke Rings Bell

The device is so sensitive to light variations that a thin veil of cigarette smoke was utilized to ring a bell in the initial demonstration. The smoke was blown so that it drifted between a light and Zworykin's mechanical optic. The smoke intercepted sufficient light to reduce the electrical current, which the illumination from the lamp had been actuating. The reduction in current caused a switch to close and completed an electrical circuit in which the bell was located. The "eye" was then used in connection with a loudspeaker which howled when a wire one millimeter thick was passed between the source of light and the photo-electric cell.

It is understood that the Westinghouse Electric and Manufacturing Company are developing a process for broadcasting pictures, and that this new tube is the basis of the system. Mr. Zworykin has pointed out that all the processes needed for television, or the projection of motion pictures by radio, are already in existence.

"The theory is all right," he said, "but at present the apparatus would have to be endless, cumbersome and uncertain. But it will be simplified. It will take some years; but we will have eventually the instantaneous or nearly instantaneous transmission of motion pictures."

By selecting the suitable electrical characteristics of the tube and the accompanying batteries, Mr. Zworykin has produced a device in which no current will flow through the tube's plate circuit when the sensitive metal film is in darkness; but as soon as light strikes this alkaline film, the electrical barrier averting the flow of current is removed and the current will flow through the plate circuit of the tube in proportion to the intensity of the light falling upon it.

Western Electric

RADIO'S SENSITIVE OPTIC

So sensitive is the Zworykin photo-electric vacuum tube to variations in light that a thin screen of cigarette smoke will act upon it and create a howl in a radio loudspeaker. Engineers expect that it will serve to broadcast light just as the microphone broadcasts sound

In daylight, or under an electric light, the current flow thus produced is sufficient to operate a standard telegraph relay, which in turn can be arranged to control electrical or other apparatus to any desired extent. By reversing connections, the effect of the operation of the tube can be reversed, so that it will produce current in darkness, but will prevent current flow although it may be fully illuminated.

The instrument is useful as a fire alarm in such places as the holds of vessels, automatic, unattended electrical stations, storerooms of buildings and other places. At the least suggestion of smoke, caused by overheating from any cause, an alarm can be sent out by both wire and radio to any desired stations. It can be employed in connection with variations of light for any purpose, such as the exact matching of colors, detection of flaws in tinplate and textiles, the turning on of street lights at twilight and extinguishing them at dawn, and for innumerable other applications of similar nature.

The reaction of the Zworykin tube to light variation is extraordinarily rapid, being on the order of one-hundred thousandth of a second, and since, when incorporated in a suitable circuit, it will send out radio impulses of any desired frequency in direct proportion to the amount of light falling upon it, it has opened the way for the development of television.

Will Radio Travel Everywhere?

C. Francis Jenkins, the Washington inventor, who has demonstrated a machine for sending silhouettes of moving objects, which some have termed the real step in the broadcasting of movies, uses a photo-electric cell in his apparatus to convert the high lights and shadows of objects into corresponding intensities of electric current. Captain R. H. Ranger, an engineer of the Radio Corporation of America, who has developed a pen-and-ink method of reproducing pictures sent by radio, also employs a photo-electric cell as the "eye" of his system.

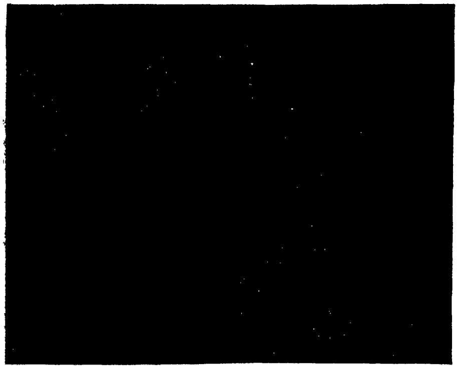
Mr. Jenkins, in explaining the essentials of television, says, "If one puts his head under the black cloth of an old-fashioned camera pointed at a baseball game he sees in miniature on the ground glass an exact reproduction of the game as it progresses. It is carried by light from the ball diamond to the ground glass screen. That is exactly what we want, only we want it in our homes. Light working alone will not do it, for light goes only in a straight line, and obstructions cut it off; we must, therefore, have some kind of carrier which can go around obstructions and through the walls of our homes. A copper wire will do, but a wire carries only to one place.

"Let us take radio that travels everywhere!"

Kadel & Herbert

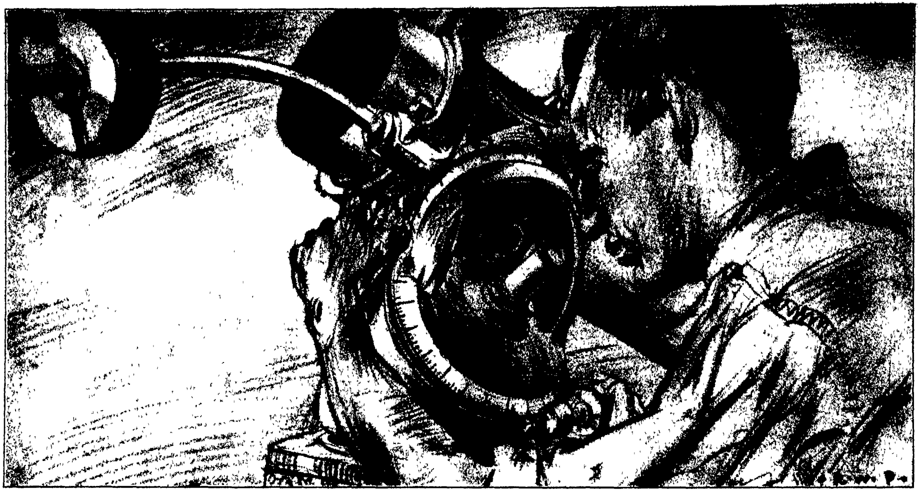
SHADOW ELECTRIC APPARATUS

The combination photo-electric cell and vacuum tube in a radio set is so sensitive that it is energized with a shower of electrons when the slightest shadow crosses its light


Wide World

A BRITON'S VERSION OF TELEVISION

Through this complex layout of wires and disks a British experimenter is seeking a system for sending pictures through space from one distant station to another by radio



The Springfield equatorial mounting, showing its fixed eyepiece and the convenient arrangement of the slow motion controls and setting circles

Mountings for Reflecting Telescopes

By Russell W. Porter, M.S.

All Drawings by the Author

SEATED well up in the bleachers (Latitude 43° N) we amateur astronomers in Springfield, Vermont, can command a fine view of the greatest of all spectacles—the solar system. Among its planets the race is always on. The entrants gain and lose on each other as they pass us by. Until Copernicus somewhat rudely shoved us over to one side, we thought we saw the show at first from a central coign of vantage. However, the change was not all a loss, for it placed us on a movable platform where we became a real participant.

I always like to think of this old earth of ours as a gigantic piece of exquisite mechanism with which, by the aid of a mirror of my own making, I am privileged to play at will. But, before I may appreciate the beauties of this mechanism, my mirror, along with its prism and eyepiece, must be properly mounted.

The Fundamentals of a Mounting

The essentials of an efficient reflecting telescope mounting are: that the optical train—mirror, prism and eyepiece—be held rigidly in relation to each other; that provision be made for conveniently adjusting these parts, and that the whole be supported on bearings, permitting any celestial object to be easily followed as it moves across the sky.

The first of these conditions is readily met by the use of a tube of sheet metal to which the different optical parts are attached. Since the hollow cylinder is one of the stiffest forms for its weight and can be obtained at any tinsmith in galvanized iron at moderate cost, the reasons for its use are obvious. The mirror A (Figure 1) rests in a cell B, fastened to one end of the tube C. The eyepiece F fits into another tube E called the adapter, which slides easily in a flanged piece D fastened to the side of the telescope tube. The prism G (hypothenuse side) is held against a corresponding face on member H. A stud on the rear of H fits in the sleeve I held to the telescope tube by the three knife-edges J. The knife-edges have threaded ends. They rest in slotted holes in the tube and are provided with set nuts. With this arrangement the prism may be adjusted to bring it into proper relation to the mirror and eyepiece.

THE SPRINGFIELD MOUNTING IN USE

The observer's position is fixed (note the bicycle seat). The light reaches his eye through two prisms

This solution of our first and second essential conditions is the one now in almost universal use. When taken indoors for safe keeping, the optical parts are easily removed without disturbing their adjustments. An additional refinement is a focusing rack and pinion. Sometimes a diagonal, flat piece of glass (silvered on its front surface) is substituted for the prism, but this is not advised because it adds an unnecessary silvered surface to be protected. The prism is not silvered and is totally-reflecting, owing to the acute angle which the light strikes its hypothenuse side.

What an Equatorial Mounting Is

The tube must now be supported so that it will follow the stars. Of the several ways by which this may be accomplished, one condition underlies them all—there must be provided two bearings at right angles to each other, and one of them must be capable of being adjusted parallel to the axis of our earth. A familiar instrument having these two bearings at right angles to each other is the surveyor's transit or theodolite. One of the axes (A-B, Figure 2A) is always plumb. Imagine the instrument tipped over until this axis is parallel to that of the earth (second drawing of Figure 2), and we have what astronomers call an equatorial mounting. The axis about which the telescope swings is called the declination axis.

To visualize this condition of parallelism between the polar axis of the mounting and the axis about

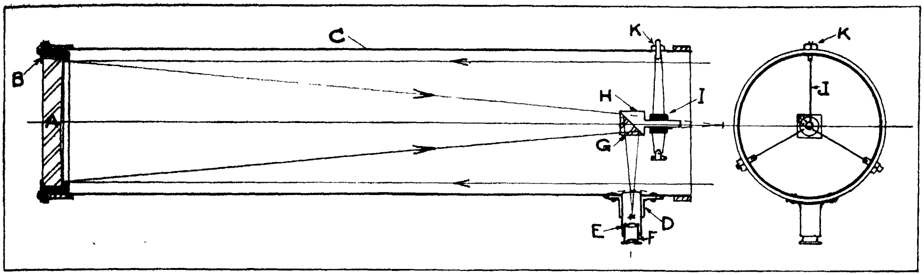
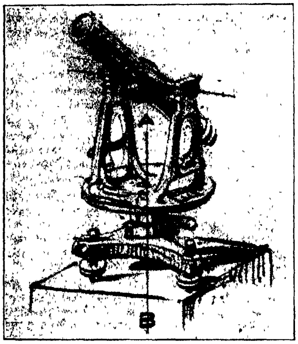


Figure 1 A typical Newtonian mounting, showing how the mirror, prism and eyepiece are attached and adjusted

which the earth rotates, I have drawn Figure 3. In this schematic diagram a mounting is shown placed on the earth's surface in about the middle latitude of the northern hemisphere. Its polar axis and the earth's axis are seen to be parallel to each other. At right angles to the polar axis is the declination axis about which the tube swings, allowing it to be pointed at any angle with the observer's horizon.

The earth, turning in the direction of the arrow, gives the stars an apparent motion in the heavens in the opposite direction, and a slow motion of the polar axis spindle of just the right amount will keep any star (regardless of its elevation above the horizon) constantly in view in the eyepiece of the instrument. When the telescope is pointed toward the pole of the heavens, stars move slowly across the field of view. *Polaris*, for example, seems hardly to move during an entire evening. But, as the tube is swung down toward the celestial equator, the apparent motion of the stars is accelerated. Thus, the motion of the moon in a high-powered eyepiece is so rapid as to give an almost overwhelming realization that the earth is turning over in space.



THE SURVEYOR'S TRANSIT

Figure 2A Mounted as shown, the vertical axis is not parallel to that of the earth. But see Figure 2B

Were the mounting to be erected at the poles, the polar axis would of course be *vertical* to the observer's horizon; if placed anywhere on the equator, it would be *horizontal*, or parallel to one's vision. In any case the polar axis of one's mounting makes an angle A with his northern horizon, equal to his latitude, for the two angles A, A are always the same, as is evident from the two triangles shown.

The most common type of mounting is known as the German mounting. The tube (Figure 4) fits into a ring A to which is attached a spindle B. The bearings C, C for this spindle are at one end of spindle D, and D's bearings, E, E are part of the casting fastened to the pier F. When D is adjusted by the screws G parallel to the earth's axis, any object in the telescope eyepiece will be held in the center of the field by revolving the instrument about D just fast enough to counteract the daily rotation of the earth.

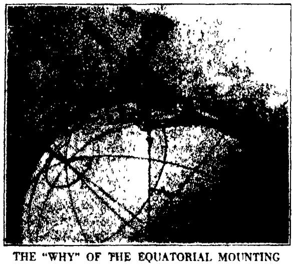
Four Common Types of Mountings

The German type of instrument is completely counterbalanced. The tube is gripped at such a point that it will remain pointing in any position without clamping. Since it overhangs one side of the polar axis, sufficient weight H is added to the opposite end of the declination spindle to bring the center of weight into the polar axis near its upper bearing. The total weight is, therefore, inside the base and is equipoised. Usually for convenience in following a star, a worm and worm wheel are provided on the polar spindle.

In the English or fork type (Figure 5) the tube is swung in a yoke attached to the upper end of the polar spindle, but considerably overhanging the pier. It has the advantage of requiring no additional counterweights.

This excessive overhang of the tube in the fork form is overcome in a third type (Figure 6) where the tube is brought within the two bearings of the polar axis, whose spindle is enlarged into a double yoke within which the telescope swings in declination.

However, all forms of mountings are compromises, and in this case the gain in rigidity is obtained at the cost of cutting off a part of the northern heavens.

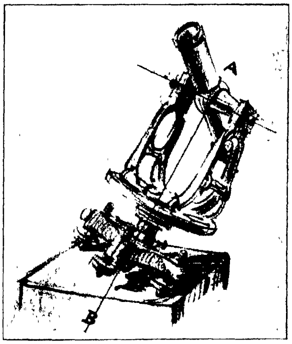


THE "WHY" OF THE EQUATORIAL MOUNTING

Figure 3 Its polar axis having been made parallel to that of the earth, the telescope will now follow the stars

This was the form adopted to carry our greatest of all mirrors, the 100-inch reflecting telescope at Mount Wilson, California.

Still another form of mounting is made by expanding the upper bearing of the polar axis to a large equatorial ring E (Figure 7) within which the telescope swings on its declination axis, the lower polar bearing being a thrust bearing at F. The large ring turns on the two rolls R, R. This mounting is very stable, the center of weight of the moving parts being well within the supporting rolls and thrust bearing. Part of the equatorial ring E is cut away in order to allow the tube to reach all parts of the heavens.



THE EQUATORIAL MOUNTING

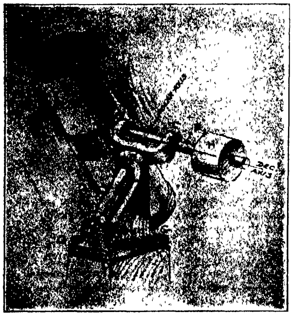
Figure 2B The transit of Figure 2A has been tilted. Its axis, A-B, is now parallel to the axis of the earth

In all of these mountings considerable machining of parts is required, also special castings, running into amounts of money beyond the means and capabilities of most amateurs. The Springfield Telescope Makers selected the first of them, namely, the German form. But these men had access to the resources of the machine shops here and were all skilled mechanics. I shall, therefore, at the risk of possible criticism, describe a wooden equatorial mounting containing the essential features, but which may be easily put together from materials available anywhere. When the mirror maker has given his glass a good tryout with this mounting he will either be satisfied with it or will become so enthused with its performance, that he will attempt something better in metal.

To hold the optical parts, a clear straight-grained plank of pine or spruce A, (Figure 8) 1½ inches thick, 6 inches wide at the mirror end and tapering to 2 inches at the other is used. The mirror rests in a 1-inch board, 6½ inches square, screwed to A, as shown, and recessed for the mirror to a depth of ½-inch.

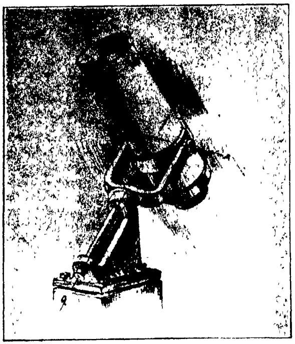
In order to prevent the possibility of the mirror falling out of its cell, wooden buttons or brass clips may be distributed around the edge of the recessed board.

At the back of the shelf which has been formed there are three adjusting screws on which the mirror rests. At the other end of A a hole is bored to take the tube C. This is a piece of brass tubing about 6 inches long, with an inside diameter equal to the diameter of the eyepiece to be used. One end of C is cut down, leaving two ears at I with enough spring in them to grip and hold the 1-inch totally-reflecting prism. Some of the tube between the plank and prism is cut away in order to offer no more obstruction to incident light on the mirror than is necessary to support the prism. The other end of the tube is slotted to allow the eyepiece to slide for focusing. So much for the member holding the optical parts. When assembled, find the point on A where it balances and bore a ½-inch hole.



THE GERMAN TYPE OF MOUNTING

Figure 4· This is the commonest of the equatorial types. It has many advantages and comparatively few drawbacks



THE ENGLISH OR FORK TYPE

Figure 5 It dispenses with counterweights but it is not as steady as some others, due to its long overhang

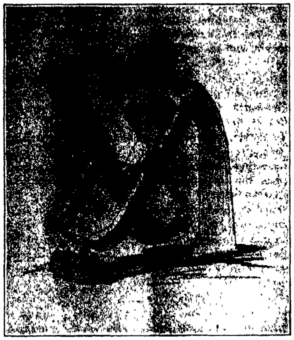
D is a block of wood 6 inches square, and 2½ inches thick. Part of one side within a 4-inch circle is recessed one-eighth of an inch. Two holes, respectively ½-inch and 1-inch in diameter are now bored through the block, as shown. When finished the latter is attached to A with a ½-inch bolt 4 inches long, provided with washers and a butterfly nut.

An Approximate Equatorial Mounting

The polar axis is a piece of 1-inch shafting about 2 feet long. Have the blacksmith bend over 6 inches of it until it makes an angle with the rest of the shaft about equal to the complement of the observers' latitude

The remainder of the mount consists of a 2-inch steam pipe 2 feet long, cast vertically into a concrete pier. When the bent end is adjusted parallel to the earth's axis by lining it up on *Polaris* some evening, cement is poured into the steam pipe and allowed to set, the block D is dropped down over the shafting in the hold provided for it, and the mount is finished.

The butterfly nut will give the desired pressure between A and D so that the telescope will turn, but will remain fixed at any required declination. If D is slotted as shown, the wood screw M will take up any looseness of the bearing of the polar axis. The mirror is adjusted in its cell until its optical axis passes through the center of the prism J (Figure 8), and this is tested by placing the eye well behind the prism and noting whether the reflection of the prism is in the center of the mirror. Should it be found, say, at K, unscrewing the screw L will make the reflection move toward the center.

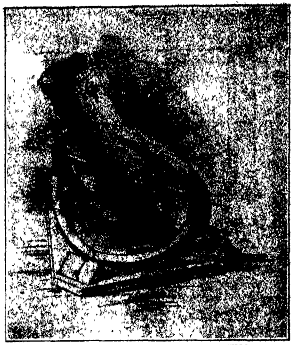


THE DOUBLE YOKE TYPE

Figure 6· Compare this with Figure 5. Having two bearings this type is very steady

The prism is adjusted by taking out the lenses of the eyepiece and looking into the adapter. The reflection of the mirror will be seen in the prism. The reflection of the prism should be central and must be made so by filing the seat of the prism. A slight movement of the prism between its ears will cause the reflection of the mirror to move and will indicate where the seat should be altered.

The focal length of the mirror has previously been found during the knife-edge tests. It is one-half of its radius of curvature. The distance from the surface of the mirror to the center of the adapter tube will therefore be this focal length, less the distance from the center of the prism to the focus of the eyepiece—(about 5 inches). For a glass of four feet focal length, the distance from mirror to adapter would be 48—5=43 inches. The focal plane of a negative eyepiece is somewhere between its component lenses; of a positive eyepiece it is just in front of the field lens.



THE EQUATORIAL RING MOUNTING

Figure 7· This type has many advantages, particularly that of steadiness. Here as elsewhere the polar axis is P—A

The wooden part of the mount should be well painted and the polar axis should be kept slushed with hard grease. The wooden member can be lifted off the polar axis and taken indoors as a whole, for it is quite light. A cap of some sort (a piece of window glass will do) should always cover the mirror when not in use. This is to preserve the luster of the silvered surface.

The Accurate Springfield Mounting

One of the most convenient of equatorial mountings (Figures 9 and 10), and the one producing the most satisfactory results here, has the advantage of a fixed eyepiece. It is true, a second prism is required. This, however, permits the observer to sit in one position looking comfortably down the polar axis for all celestial objects. The two controls in right ascension and declination are within easy reach (see page 164), the setting circles are large and need no verniers. The tube is counterpoised and can reach all parts of the heavens. Loss of light by the additional reflection through a second prism is negligible.

Light from the mirror, after reflection from the usual prism A in the tube (Figure 9) passes through the hollow declination stud B, to another prism C, directly over the polar axis stud D, and below the eyepiece In addition to its fixed eyepiece a distinctive feature of this mounting is the manner in which the two axes are maintained. Instead of two spindles held in bearings at their extremities, the bearing surfaces consist of large areas held together with small central studs, that of the declination axis being hollow. This arrangement permits very rigid forms to the three castings I, II and III. The setting circles c and d are cut on member II in convenient positions for reading.

Control in motion is as follows: the two tangent screws a and b (Figure 9) bear against spurs on the edges of two thin sheet steel discs inserted between castings I, II and III. Figure 10 shows the detail of slow motion about the polar axis. The spur on the periphery of disc D, bears in the circular groove C of screw B. Sufficient friction is maintained between the bearing surfaces of the discs so that not only will the tangent screws produce slow motion to either axis, but will also allow the telescope to be swung quickly through large arcs of the heaven in both declination and right ascension. This arrangement makes a very good substitute for the expensive worm wheel drives.

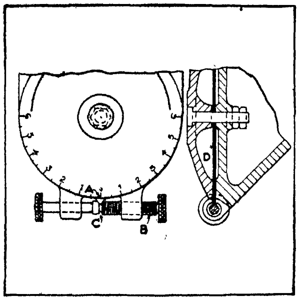
The Hartness, Turret Telescope

Of the many designs of mountings which enable the observer to sit in comfort in an enclosed and warmed room, space here forbids treatment. The most notable of these among amateurs is the Hartness turret, described in the Scientific American, March 9, 1912, in which the roof of the building, made of cast iron, rotates on rolls, carrying the optical parts and delivering the light from a ten-inch objective to an eyepiece inside the room. Bell, in his book, "The Telescope," describes this and several similar mountings.

Mention only, has been made here of the Newtonian reflecting telescope. There are, however, others, but they are not as practicable for the amateur as this type. In the Gregorian type a small, concave mirror just outside of the focus is substituted for the prism. It reflects the light from the mirror to a secondary focus lying behind the mirror, through a hole in the center of the glass. The Cassegrainian type is similar, except that it interposes a convex mirror just inside the focus. Both of these combinations greatly increase the virtual focal length of the mirror without increase of tube length, but they are useless for day work on terrestrial objects and they require the figuring of an additional optical surface.

With an equatorial mounting providing with setting circles one can select any celestial object (above the horizon) by looking it up in the Ephemeris and setting the circles to the correct declination and hour angle. One also sets his watch to running on star time. If he has made no blunder in his calculations and the instrument is in fair adjustment, the object will appear in the field of view of the eyepiece. It may be an obscure double star, or a nebula, or a cluster, or a comet, wholly invisible to the naked eye and impossible of locating in any other way. Thus the desirability of owning a mounting provided with circles is seen, if one wishes to delve into the great storehouse of hidden wonders above us.

On the other hand, the simple wooden mounting which I have described will enable one to pick up all of the apparent celestial bodies—the moon, planets, sun spots, bright double and multiple stars, two nebulae visible to the naked eye, and one or two star clusters.



HOW THE STARS ARE SLOWLY FOLLOWED

Figure 10: Detail of the slow motion, front and side elevations. This is a part of Figure 9

Care must be taken in observing the sun, for the mirror makes a powerful burning-glass It works best for this purpose while still unsilvered, but if it is silvered, cover the glass with a cardboard in which an inch hole has been cut. The safest way is not to use the eye at the eyepiece but to project the sun's image on a card placed outside the eyepiece.

It is hoped that the amateurs will not copy these mountings slavishly, and partly for this reason set dimensions are not given except in a few instances. When controlled by a clear comprehension of the principles of the mountings used and some mechanical judgment, the exercise of the amateur's individuality in planning his telescope is highly desirable. This suggestion will, it is hoped, obviate the production of a large number of telescopes, as like as a lot of peas. For example, Mr. Clarendon Ions, of Miami, has built an ingenious equatorial mounting almost entirely from discarded parts of a Ford car.

Eyepieces or oculars for astronomical telescopes are usually the Hyghenian type in 1¼-inch tubes Their powers vary according to their equivalent focal length *(e.f.l.)*. For our telescope of 4-foot focal length an eyepiece of 1-inch *e.f.l.* would give 48 magnifications (the focal length of the mirror divided by the equivalent focal length of the eyepiece). A ½-inch eyepiece would give 96 magnifications and a ¼-inch, 192 magnifications, respectively This makes a good battery of eyepieces for range of powers. They cost from about six to ten dollars apiece.

Were I to have but one eyepiece at first, it would be the low power, viz, 1-inch *e.f.l.* The Hyghenian eyepiece is not, however, achromatic, and the color is quite noticeable in a mirror telescope. I have used almost exclusively the Hastings, three-lens, positive oculars, which give a beautiful, flat and colorless field

Eyepieces from old microscopes are not to be despised and they work very well with a mirror. They are usually of low power and are useful for terrestrial observation It is not advised to use a higher power than ¼ inch *e.f.l.*, as the atmospheric disturbances and the quality of the mirror surface set a practical limit to the magnification

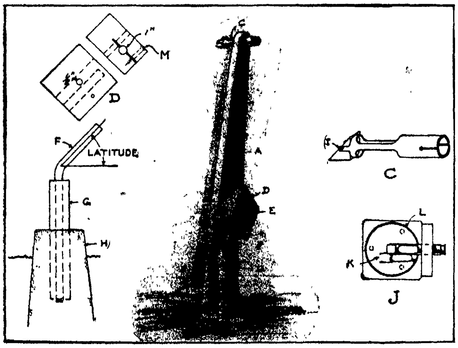
Literature and Materials

A finder is a small telescope fastened to the eyepiece end of the telescope as an aid in pointing the tube to any desired and visible object. They are undoubtedly a convenience in picking up a star quickly, although we usually get along here by sighting along the tube itself. Of course, with one's mounting provided with setting circles, in good adjustment, a finder is unnecessary.

Literature on mountings includes the following: "The Polar Reflecting Telescope," by R. W. Porter, *Popular Astronomy*, May, 1916. "The Enclosed Observing Room," by R W. Porter, *Popular Astronomy*, May, 1917 "A New Form of Telescope Mounting," by R W Porter "The Telescope," by Louis Bell "The American Ephemeris and Nautical Almanac" (Supt. of Docs., Washington, D. C.) "The Amateur's Telescope," by Ellison (reprinted by the Scientific American Publishing Company).

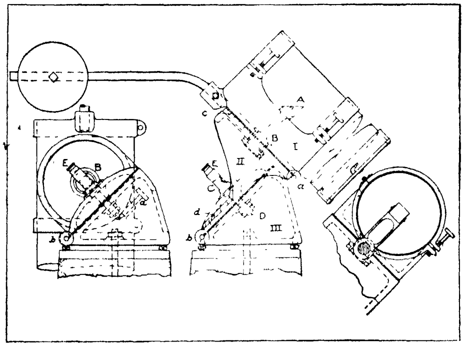
Materials may be obtained as follows: Prisms and eyepieces from the J B. McDowell Company, 1954 Perrysville Avenue, Pittsburgh, Pennsylvania; also, the Spencer Lens Company, Buffalo, New York Working blueprints of an equatorial mounting for a reflecting telescope with a fixed eyepiece; also prisms, eyepieces, from John M Pierce, 11 Harvard Street, Springfield, Vermont.

¶ *Later in the year it is hoped that photographs of the various telescopes made by our readers, with their makers included, will be received for publication. With the publication of these pictures in view the individuality displayed should be of great interest*



A WOODEN, EQUATORIAL MOUNTING THAT ANYONE CAN MAKE

Figure 8: A fair approximation of the equatorial type is obtained, simply by bending the metal shaft F, until it is roughly parallel with the earth's axis



TWO ELEVATIONS OF THE SPRINGFIELD EQUATORIAL MOUNTING

Figure 9: This is the mounting shown on page 64 and on the cover Since it is equipped with setting circles, a star may be located with the aid of the Ephemeris

Aviators laying a cloud of gas over a forest. This may be the solution of the gypsy-moth and boll weevil problems

Peacetime Uses for "Poison Gas"

A Wartime Weapon Is Made to Serve Mankind

By D. H. Killeffer

Secretary, New York Section, American Chemical Society

If you have boll weevils in your young cotton, a cold in your head, valuables to protect from bandits, mobs to disperse, or marine pilings that are being attacked by teredo worms, your best bet is to use "gas." In spite of the efforts of sentimentalists to consign chemical weapons—"poison gas"—utterly to the consuming fires of Tophet, peace is developing multitudes of valuable uses for them little, if any, less important than their service in battle. Both the materials and the methods used in the war between men and nations are proving of the utmost service in man's constant warfare against the pests and parasites which prey upon him and his works.

If such peace projects are to be discountenanced because they are of a nature readily convertible to wartime usage, with all the supposedly inhumane and cruel results, one must confess himself unwilling to approach the subject with any degree of open-mindedness, as the facts on record fail utterly to support such a contention. To obtain a true view of the facts, one must brush aside, as biased and interested, the various statements which were made during the war years in order to urge the United States into the conflict, and look frankly at the records of the war prepared by the best informed authorities for no other purpose than as a matter of history.

Gas Prevented Tuberculosis!

The report of American casualties by the surgeon general shows that some twenty-eight percent of all the injuries suffered by our soldiers during the World War were caused by gas alone, a not inconsiderable item when added to it is the fact that less than one percent of the cost of the war was spent on this weapon.

But the record further shows that only two men died out of every hundred injured by gas, while twenty-four died out of every hundred wounded by shot, shell, shrapnel, bayonet and other weapons. In other words, the man who became a casualty from gas had twelve times the chance of recovery that the one injured otherwise had. It is also important that, according to this record, only one man in 2,300—a vanishingly small proportion—of those gassed were permanently injured, while one in fourteen of those injured by other weapons, but not killed, lost at least an eye, an arm, a leg, or the use of one or more joints. Because it is most conveniently available these statistics are taken from the American casualty record. The data for the other armies engaged differ only slightly from these figures.

At the time of the Armistice, no one knew what would be the later effect of gassing on the men who had apparently recovered. Many of them were seriously warned to expect to die within five years, and others, that pulmonary tuberculosis would surely overtake them. The passage of time has shown conclusively that these well meant warnings were quite groundless and only served to disturb the minds of veterans. However, they were so fully believed that some 300,000 applications for aid were made to the Veterans' Bureau by men who believed themselves suffering from the delayed effects of gas, when the official records show that only some 70,000 American soldiers were gassed during the war seriously enough to need attention!

Chemical Warfare Service

A CURE FOR COLDS

Pulmonary disorders are treated in an air-tight chamber. The chlorine controlling device is under constant observation

No less authority than that of the surgeon general, supported and amplified by the sworn testimony of Dr. Albert P. Francine (medical consultant-in-gas with the Fourth Army Corps in France and an earnest student of post-war developments among gassed men), before the Select Committee of the Senate on Investigations of the United States Veterans' Bureau, states that far from causing tuberculosis, gas actually prevented it. In their statements that gas left no serious after-effects, both the surgeon general's official report and Dr. Francine's testimony were later fully confirmed, through their replies to a questionnaire on the subject which was widely distributed to medical men in both this country and Europe.

Few of These Weapons Killed

In the face of such facts, one can hardly hold that gas in war is the heinous invention it is commonly pictured. Nor need one fear that the development of peace uses of this weapon will lead us more quickly into war than the arming of our police and our hunters with deadly weapons of another sort.

The peace value of chemical warfare depends more especially upon the methods developed for war which are applicable to peace problems and to intensive study of poisonous and disagreeable materials. The ordinary term, "poison gas," applied to chemical weapons has led the majority of people to overlook two essential facts: few chemical weapons are actually lethal poisons, and even fewer of them are gases, surprising as it may seem. It is quite impossible to kill a man with the majority of chemical weapons because they so discomfort him that he will not stay in their vicinity long enough to get a fatal dose; and even if he were to do so, few of these weapons would kill.

Actual gases, however poisonous they may be, are seldom usable in the open—and the battlefield can scarcely be put under cover—because of their strong tendency to dilute themselves rapidly in the surrounding air and thus prevent the building up of a high enough concentration to cause death. Of course, the first large-scale gas attack, against Ypres in April 1915, was made with an actual gas, chlorine. In spite of its apparent success against unprotected troops, the prompt development of masks to keep it out, coupled with its tremendous cost, when used in a cloud, led to the abandonment of this sort of attack.

Chlorine has been known and used in commerce in huge quantities for several decades. Our water supply is purified by it, our clothes are bleached by it and it has been—in the form of chloride of lime—one of our most valuable disinfectants. As a war gas it failed on account of the ease with which it could be kept out of the lungs of the soldiers. However, it soon was observed to have a very beneficial effect in keeping the nose, throat and lungs free from bacterial infection. Hence, a study of possible means of applying it war fashion was made. In very low concentrations in the air—little more than enough to smell easily—it has been found to prevent and cure colds, influenza, bronchial infections and even to reduce the dangers of tuberculosis. Here we have a definite argument against the widely cherished fears of gas as a cause of pulmonary disorders, for this one actually cures them. Last year (1924) many submitted to the chlorine treatment for colds and were easily cured.

Tear Gas Effective But Harmless

The method of treatment consists in having the patient sit in a chamber the air of which contains a faint trace of chlorine—0.02 milligrams per liter of air—for an hour or so. In a report of experiments along this line in the Journal of the American Medical Association, Drs. Vedder and Sawyer state that of 931 persons so treated for a variety of acute and chronic pulmonary complaints, including laryngitis, pharyngitis, bronchitis, whooping cough and influenza, 71.4 percent were completely cured and 23.4 percent were materially benefited.

Among those chemical weapons which are neither poison nor gas, "tear gas" is finding the widest use in peace for the identical purpose that made it valuable in war. A whole group of quite non-toxic materials were used in the war to affect certain parts of the human system and to make the soldier as uncomfortable as possible by forcing him to wear a gas mask which was hardly less uncomfortable than the tears, sneezing and vomiting it was intended to prevent. These agents were not intended to produce death, but rather to penetrate the mask and force its wearer to remove it, laying himself open to injury by poisonous materials sent over at the same time.

Chemical Warfare Service

A HAND GRENADE BURST

In this photograph, however, it is burst for the purpose of spreading disinfecting gases, not as a deadly weapon

Tear gas (cyanogen chloride, or C N. for short) does nothing but produce a blinding irresistible flood of tears. Once started, nothing can stop them until the weeping eyes are entirely removed from the contaminated atmosphere, and in the meantime the victim is quite helplessly blind. After a few minutes (less than ten) in a clear atmosphere the tears and smarting stop and even the most skillful oculists cannot detect the slightest signs of permanent injury. Certainly the handling by machine and riot guns of mobs which refuse to be scared, is sure to result in injury to someone, while tear gas as it is used, mixed with smokeless powder in special, non-fragmenting hand grenades, developed for the purpose, in blank cartridges and in policemen's billies, cannot cause any permanent harm.

In addition to the police use of tear gas, jewelry establishments throughout the country are being equipped with apparatus for releasing it by the foot, which renders the bandit who may threaten robbery, as helpless as a babe. To the uninformed, gas has a great element of fear connected with it, as witness the prompt dispersion of the mobs in the Mingo mining district at the mere threat of its use.

At Austin, Texas, some months ago, the courthouse became so infested with bats, rats and their accompanying vermin as to threaten the dignity of the tribunals therein. Non-persistent, penetrating chemical weapons were used and, behold, the pests were no more. Ships' holds must frequently be so treated, and the only satisfactory fumigant which the public health service can find for this purpose is hydrocyanic acid, a deadly poisonous, almost odorless gas. It has the drawback, however, of giving no warning of its presence and many lives have been lost by men going into ships before the atmosphere has cleared. To correct this, small amounts of tear gas are generated now along with the highly toxic hydrocyanic acid and everyone is promptly warned of threatened danger by copious tears.

Its Use Successful Again Insect Pests

Two other types of pests are being fought by chemical weapons, the insects preying upon our vegetation and the teredo worm and other marine borers, which annually destroy immense numbers of wooden structures, ships and piers in salt water. The cotton boll weevil is, perhaps, the most destructive of the insect pests, and scores of others, the gypsy moth and the peach borer, particularly destroy wealth in quantity. It is proposed to put these and their kind out of business by laying a cloud of poisonous smoke (a characteristic war trick) by airplane over the infested areas. Experiments so far indicate that greater success will be thus attained more cheaply than by present methods of spraying and dusting. It should be easily possible to kill the insects in vast fields and forests by such a method, once the details are worked out.

All the tribe of marine borers are refusing to touch experimental pieces of piling treated with some of the near relatives of the war gas, Lewisite. Chlorovinyl-arsenious oxide and phenyl-arsenious oxide are proving more effective in protecting wooden submarine structures than any of the treatments now in use.

No discussion of the peacetime activities in gas research could be complete without mention of the defense that has been developed against carbon monoxide (probably the most deadly of all to man), hydrocyanic acid, chlorine, ammonia, sulfur dioxide and a number of others which frequently kill perfectly peaceable men. Carbon monoxide is present in city gas and kills quickly without warning. The development of a gas mask to keep it out was a difficult problem but it has at last been solved, a reasonably comfortable mask devised, and an efficient absorbent found. All the other ordinary gases can be kept out and the lives of many public servants (firemen and miners especially) can thus be saved.

Chemical Warfare Service

A TRAVELING DISPENSARY

Several of these units for the treatment of colds, et cetera, with chlorine are now being operated by the Red Cross. Such a service would be particularly effective during epidemics

Pacific & Atlantic

A PEACETIME GAS ATTACK

Workmen putting the finishing touches on a tennis court in Hollywood, California, using chemicals that produce a deadly gas. Twenty minutes only can the men work continuously

Telephoning Beneath the Sea

Using Sound Waves Above the Audible Frequency, the Navy Has Developed a New Way to Telephone Secretly Through the Water from Ship to Ship

By Nell Ray Clarke

FOR the first time in history a submarine telephone has been perfected which gives real promise of direct and uninterrupted communication between submerged submarines, between a submerged vessel and a ship on the surface, or between a submarine and a shore station.

It is not a radio device; it has nothing to do with radio. It is a reversion to the principle of the telephone pure and simple—the transmission of voice by sound waves.

Submarines cannot be very effective until they are able to talk to each other and thereby co-ordinate their battle maneuvers. They have been hampered always by having to work singly or out from a shore base or from a mother ship.

Heretofore, all devices for direct underwater communication have been failures. Submarines have been able only to rise to the surface of the water and receive radio signals from such powerful stations as Arlington Radio Station. Long wavelengths can penetrate the water to a depth of from 20 to 30 feet, but short waves cannot be received. Furthermore, the submarine was unable to answer the communication,—a very serious handicap—because it is impossible to transmit electrical energy from submerged antennas on account of the high electrical conductivity of salt water.

If the new apparatus perfected at the Naval Research Station, Belleview, D. C., proves as effective for long distances under the ocean as it has already proved for two-mile distances beneath the Potomac River, the officer in his cabin can simply pick up a telephone exactly like the one on your desk and talk to the commanding officer of another submarine with as much ease as you talk to a friend a few city blocks away.

Making Inaudible Waves Audible

The idea on which the instruments are based is not new; scientists have been working unsuccessfully along the same lines for years, but they have always tried working with audible sound waves—the same sound waves that are used in voice transmission by land.

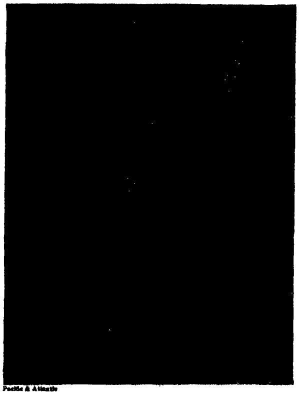
One of the scientists of the Naval Research Station then decided he would try the inaudible sounds. He began experimenting with the short waves, or the "supersonics," as they are now familiarly called in the Navy Department. To his astonishment and delight he found that these waves could be directed. He devised a telephone by means of which the voice sounds are transmitted on the supersonics from one vessel to the other and then are superimposed on audible waves, or heterodyned, at the other end and are then heard through the ordinary telephone instrument.

He has now perfected his instruments to a point where it is possible to direct these very high-pitched sounds in a beam which can be turned in any direction, as we do the beam of a searchlight, and therefore, in the particular direction of the vessel with which he wishes to communicate.

The chief advantages of this type of sound telephone over any previous means of underwater communication are: 1. Nobody or no ship can hear the message except the one toward which it is directed. The element of secrecy thereby provided is immediately evident. 2. By putting on several transmitters, a submarine can talk to a fleet of submarines at one time and plan an active campaign and even serve as headquarters from which operations can be directed.

But, in order to do this, the instruments must be tuned to one another. That means that the United States will have all its subsea telephones tuned to a certain wavelength, which is done when the instrument is made. This is a mechanical tuning. The instruments will send only one wavelength and receive only one.

As long as the wavelength on which the instrument operates is kept secret, there will be no danger of an enemy submarine tuning in to catch the messages. And even should an enemy find out the wavelength, enemy vessels would have to be equipped with the apparatus for receiving the message at such a time as it might get into the direct beam of the sound—a situation which might happen, but is not probable.


Pacific & Atlantic

DR HARVEY C. HAYES, THE INVENTOR

A closeup of the electrical apparatus for transmitting the voice from one point to another under the water, as it would appear set up in the submarine

Experiments now being conducted at the Naval Research Station hold out an alluring future for the instruments. The apparatus is simple and inoffensive looking. The same harmless transmitter, which resembles the top of a fireless cooker, is also used for the receiving disk. It is made of two circular plates, each being about as large around as a saucer. Between them are thin sheets of quartz crystal of the Piezo-electric type. The plates are mounted in a circular piece of steel, which in turn is mounted in the end of an iron container, a pipe-like affair on the bottom of the ship or on the side of the submarine, so that it comes directly in contact with the water.

Electric wires, carrying an alternating high-frequency current, pass through the pipe and are attached to the steel plates. When the current is sent over the wires, the quartz between the plates expands and contracts and sets the disks in motion just a little.

It is these small movements of the disk which send out through the water the super-sound waves. A receiving instrument exactly like the transmitter on the other vessel to which the communication is addressed vibrates in sympathy with the wave and sets up a current in the instrument, which is heterodyned down to a wave the human ear can hear.

Up to the present time, the instruments have not been tried out on submarines, but experiments are being conducted from two barges which have been towed out in the Potomac for the tests. Not only have the men been able to talk to each other at distances of two miles or more, but every quality of the voices is reproduced perfectly. In transmitting, the carrier sound wave is modified by voice inflections and the modifications come back through the detector.

To make assurance of the reproductive quality of the instruments doubly sure, the men have played phonograph records near the instruments, choosing the most difficult operatic selections, but the selections have come over as perfectly as if the phonograph were in the same room.

The high-power vacuum tubes, commonly used to supply energy in radio transmission, are being used for the alternating high-speed current, and the telephoning is being done at a pitch of 120,000 kilocycles. This is astonishing in view of the fact that the human ear can ordinarily hear only the sounds at a pitch of from 30 to 30,000 kilocycles.

There seems to be only one kink in the new method that may give trouble, and that is due to the fact that sound waves travel much more slowly than radio waves. It takes a sound wave in water five seconds to travel four miles.

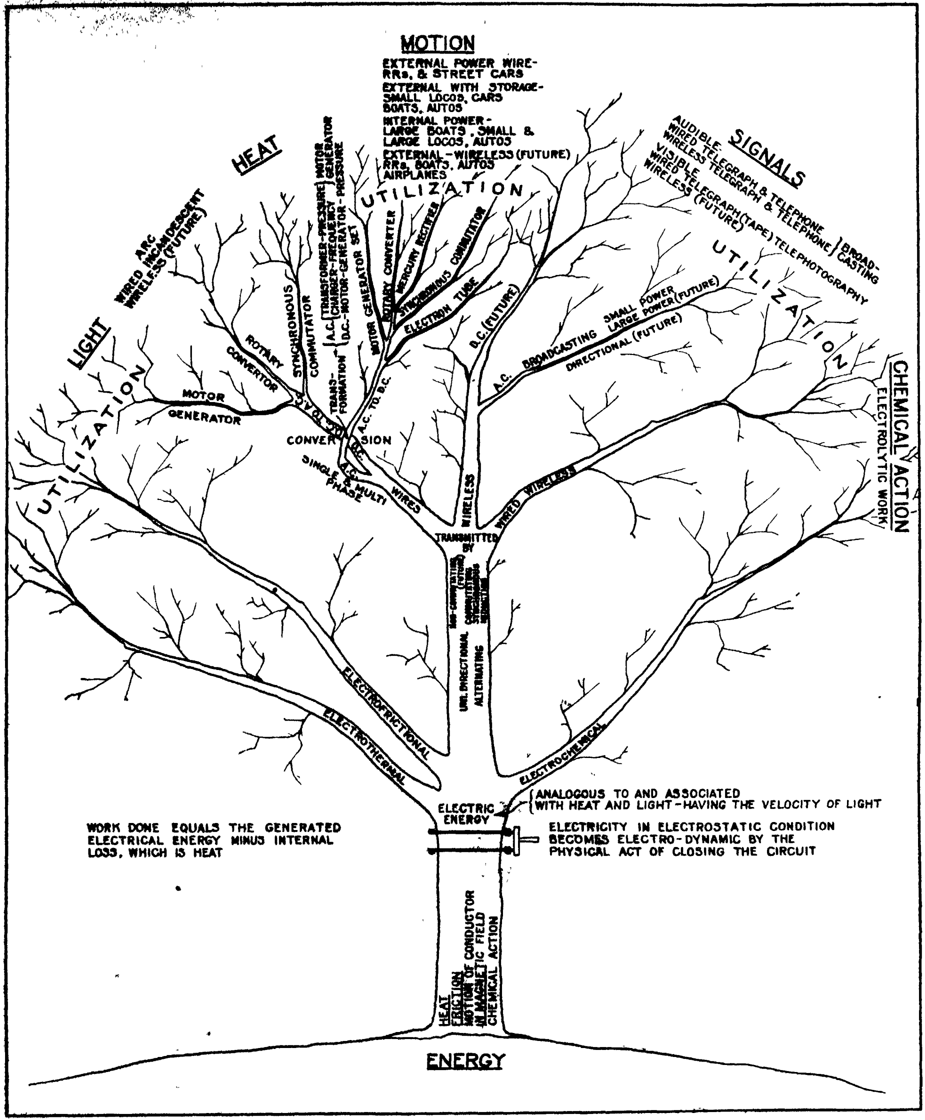
Short Waves Solve the Problem

The real secret of the invention lies in the peculiar behavior of short sound waves as distinguished from the long ones. Waves always have the tendency to travel out in every direction from a diaphragm. In using the instruments of the Fessenden-oscillator type, previously thought to offer the solution of the underseas communications problem, long sound waves are sent out in every direction, but upon coming in contact with the irregular ocean bottom they are reflected back in echoes to the instrument which sent them out.

These echoes of the original signal become so confounded with each other that there seems to be no possibility of interpreting a message. For instance, if an operator sent out a dot and a dash, he probably would get from five to eight or more echoes of each sound. Before all the dots came in, the dashes would begin coming in.

The short waves—and by short waves, always is meant short with respect to the diameter of the transmitter—also travel out spherically from the oscillator, but they have a tendency to neutralize each other, a fact well known to students of the action of sound waves. As a result, those which travel out from the steel disks in straight, parallel lines are the only ones left to transmit the sound, and it is these waves which make a beam that can be directed.

The audible waves, on the other hand, due to the distance between their crests as compared with the dimensions of the sending apparatus, do not neutralize each other so readily.



Compiled by L. S. Treadwell, Associate Editor Scientific American

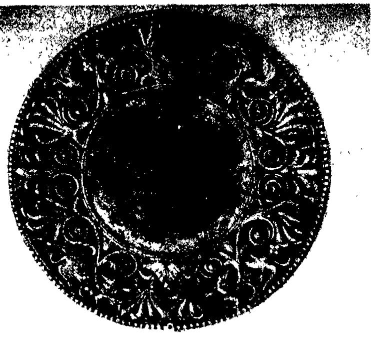
A Tree of Electricity

It is impossible to clearly delineate all the ramifications of electricity. We give, therefore, only the principal applications to show their inter-relation

Photographs courtesy of the Metropolitan Museum of Art

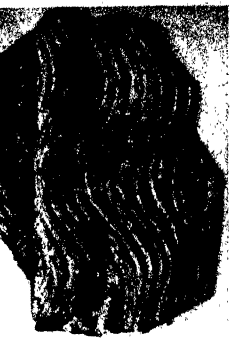
BRONZE STRIP BEFORE TREATMENT

A part of a decorative panel, completely mineralized, yielded to electrical treatment with astonishing results. Dilute caustic soda and electricity reduced the outer coating to sponge copper



A GREEK MIRROR

This mirror was submitted to microscopic and other tests to determine its genuineness. On the basis of these examinations it was concluded that the mirror was of ancient origin. The mirror was at one time fastened to a wooden backing. The frame was protected by a thin layer of gold



BRONZE STRIP AFTER TREATMENT

After the rough bronze shown on the left was treated by electricity, the sponge copper was removed with nitric acid, showing the gold leaf, one-tenth the thickness of a human hair

The Restoration of Ancient Bronzes

How Corrosion of Antique Works of Art Is Halted and Restoration Is Accomplished by a Process of Electrolysis

By Colin G. Fink and Charles H. Eldridge

THE restoration of antique works of art has always been more or less shrouded in mystery. Fortunately, however, we are now able to present a new method of restoration, based on scientific principles, the result of the collaboration of Columbia University and the Metropolitan Museum of Art. The director of that institution, Dr. Edward Robinson, goes into the general subject briefly in a pamphlet issued by the Metropolitan Museum of Art:

"Diseased" Specimens Affect Others

"It is a general impression among visitors to museums that once a work of art has been properly installed, once it has been set on a pedestal or hung upon a wall, and more especially if it has been protected by glass, its life is assured for an indefinite future. So far is this from being the fact, however, that exactly the contrary might almost be true. Many objects bring with them the germs of deterioration, if not of actual destruction, others, though sound when they are received, are highly sensitive to relative degrees of heat and cold, moisture and dryness, and to the atmospheric impurities of our modern cities, never so serious a menace as they are today. These dangers are not confined to any one material or class of material. Indeed, there are very few—if any—which can be regarded as immune from one or another of them, and when we add to this the knowledge that one 'diseased' specimen in a showcase may and frequently does infect others, it will be realized that eternal vigilance is the price at which a curator keeps his collections in condition, though he is often at his wit's end to know how to arrest or prevent the disaster with which he finds himself threatened. One is the corrosive green crust with which objects in bronze or other copper alloys are apt to become thickly coated through long burial in the earth, and which not only completely hides the details of the modeling and the engraved designs but frequently eats deeply into the surface of the metal itself, thereby rendering the object valueless, and sometimes destroying it altogether. The other is what is now familiarly known among collectors as the 'bronze disease.'"

We began our studies and experiments in January, 1923. The object of our investigation was to start with specimens of badly corroded bronze and to so treat them that the ugly crust should be removed and any detail of shape, design, engraving, tool mark, or other signs of workmanship remaining on the specimen might be restored or preserved intact.

International Newsreel

DR. COLIN G. FINK IN HIS LABORATORY

He is the discoverer of a new method of restoring antique bronzes and silver by electro-chemistry

It is generally conceded today that the corrosion of metals and alloys is due to an electrolytic process; and it occurred to us that if this electrolytic process of corrosion could be reversed, a method might be devised whereby the metal compounds in the crust would be reduced back to metal. This line of attack of the problem seemed most hopeful, since other methods, such as dipping the bronze into strong mineral acids, are far too radical and seldom produce satisfactory results.

It will be appreciated at once that any acid method is very difficult to apply, since it is almost impossible to regulate the action of the acid in such a way as to avoid the pitting of the underlying metal when such exists. Furthermore, the metal contained in the compounds of the incrustation is removed by the acid, whereas in the ideal case it should be reduced and put back into place. In the case of completely mineralized objects, acid would destroy them beyond redemption.

Object Made Cathode

We have given a large variety of methods a most careful trial and observed the results. We very soon decided in favor of an electrolytic method of attack. The fundamental idea was to replace cathodically the metal that had passed into the crust rather than to completely eliminate the crust with its metal content by corrosive acids or by mechanical means.

In developing our electrolytic process we tried out various electrolytes used by earlier workers, as well as other electrolytes suggested by our own laboratory observations. We finally decided upon a two percent solution of caustic soda as the safest electrolyte to use. Finkener's electrolyte of two percent potassium cyanide was found to be unsatisfactory.

Without any preliminary cleaning, the bronze object to be treated is hung as cathode (as will be explained below) in the two percent caustic soda solution, and a low amperage direct current is applied. The object is suspended with soft copper wires and is completely immersed in the solution. In case the object is very soft and fragile or is completely mineralized, fine, annealed copper wire is wrapped

COPPER TRAY BEFORE RESTORATION

This tray was about six inches in diameter. It was corroded and covered with a hard green crust

around the object, one to two turns per inch, and electrical connections are made with several turns of this wire. The anodes are hung on either side of the object. (The anodes are the poles or electrodes at which oxygen gas is evolved during the passage of the current.) Iron, duriron, and platinum anodes have been used with success. A rectangular glass battery jar with a capacity of one and one-half quarts serves well as a container for the treatment of small bronzes. For large objects we have used stoneware tanks; and there is no objection to the use of large tanks made of heavy sheet iron welded at the joints. The object being treated is always made the cathode—that is, that pole or electrode at which copper, gold, silver or other metal is deposited during passage of the current.

The action of the electrolysis is to precipitate metal at the cathode and to reduce the crust to finely divided or spongy copper. If the cell is operated for a longer time a compact deposit of metal is obtained. If the object treated originally had a hard metal surface under a thin sandy layer of crust, we may remove the reduced copper film or layer by a gentle brushing with a stiff bristle brush or soft brass-wire brush. The first step in each case is to submit the object to a very careful examination. It is measured and weighed, the crust of patina is studied and analyzed to get an estimate of the probable composition of the underlying base

In the course of our investigations on ancient bronzes, we have had occasion to examine a number of objects concerning which there was some uncertainty as to whether or not they were genuine antiques. It need hardly be mentioned that there are a large number of spurious antiques sold to people who are not familiar with even the simplest means of determining the composition and age of the object

Just as there are means and methods of detecting a counterfeit "Rembrandt," so likewise are there methods of detecting an imitation or spurious "antique" bronze. Although it is true that absolute identification of the fraud is not always possible, in the large majority of cases we can, by a systematic method of physical, chemical, and metallographic analysis, determine whether or not the bronze or other alloy is of comparatively recent origin.

We have divided our method of investigation and procedure into three distinct steps:

1. Microscopical examination of the patina or crust.
2. Metallographic examination of the metal core.
3. Chemical analysis of the metal.

In the examination of the patina we may find distinct crystalline growths of malachite or azurite, the tiny crystals partially imbedded in the underlying oxide film. Such crystalline growths are most difficult to imitate and patinas of recent origin are almost always amorphous or non-crystalline. Nevertheless, the patina may be recently formed or applied and yet the bronze may be genuine—in fact, very many of the genuine bronzes exhibited nowadays have patinas of recent or artificial formation.

Corrosion Products in Layers

Accordingly, if the microstructure of the malachite or azurite particles in the crust or in the patina is distinctly crystalline and interlaced with the copper oxide layer, the bronze is very likely genuine. But an amorphous malachite deposit does not necessarily imply that the underlying bronze is not genuine.

Under the outermost coating of malachite or azurite or clayey material, there usually is found, in the case of genuine bronzes, a layer of copper oxide, reddish-brown to reddish-black in color. It is usually of considerable thickness and is not readily applied by any rapid artificial process. Furthermore, very often the products of corrosion are imbedded deeply in the metal next the crust.

In the metallographic examination of the bronze we find additional proof as to whether or not the bronze is genuine. Taking a very fine slice of metal from some inconspicuous part of the bronze, and preparing this by polishing and etching for microscopical examination, we noted in the case of a genuine bronze that there is a gradual change in structure as we pass to the outer exposed edge of the bronze; furthermore we sometimes noted changes in the size of certain crystal components of the bronze, changes that are brought about by a very slow process of "annealing"

COPPER TRAY AFTER RESTORATION

After electrolytic reduction and restoration, the design engraved on the copper was revealed almost completely

Chemical analysis must be carried out with great care. The results may support the findings of the metallographic investigation by determining chemically that the main body or interior of the bronze has a decidedly different composition from the layers under the outer oxide or patina surface

In conclusion we would like to quote from Dr Robinson's introduction to the museum pamphlet·

"We are now well on the way to salvaging brilliantly thousands of bronzes which might otherwise have been ruined by crude attempts at 'cleaning' or discarded altogether as worthless The artificial patination of such objects as may require it after treatment, and the cure or prevention of the bronze disease, still call for further study, but considerable progress has been made in both, and we are justified in believing that satisfactory solutions are not far distant. The museum official or collector who hopes to find in this report a ready-made formula for treating bronzes which anybody can apply will be disappointed. While Dr Fink and Mr Eldridge have shown that ancient bronzes can be cleaned and preserved, they have demonstrated with equal force that this can be done only by a highly trained expert who watches and deals instantly with every symptom that develops during his treatment.

A GREEK BRONZE GOAT

This little bronze goat was covered with a hard gray-green crust. The fore feet were encrusted and cemented together

BEFORE AND AFTER TREATMENT

Left: *A bracelet of round silver alloy wire.* **Right:** *An oval bronze bracelet with snakes' heads at the ends*

THE BRONZE GOAT RESTORED

The goat was submitted for three days to the electrolytic process, which restored it to the condition shown above

TWO EXAMPLES OF PISE HOUSES OVER 150 YEARS OLD

This house built in 1773 of rammed earth is now standing at 13th Street and Rhode Island Avenue, Washington, D C.

Built in 1773, the owner attempted to demolish it The walls were so hard that they were retained in the remodeled structure

More Mud Houses

An Ancient Method of Building Which Has Been Revived in Europe and is Now Being Put to Good Use in America

By Karl J. Ellington

Photographs by Courtesy of the Author

IN North Africa whole cities are built with pisé — rammed earth The Moors brought the method into Spain, where we find the many centuries old Alhambra palace (Granada) is built in some parts of this material. The Romans knew and used the method. In Southern France old pisé houses are plentiful, and it is from France we have the term *Pisé de Terre*, commonly shortened to *pisé*.

We have some old buildings here in America, in fact it is quite probable that the pisé method was in use on the American continent earlier than in any other part of the globe. In Central and South America the pre-historic races have left some remarkable architectural creations, among which can be found proof that these people also knew how to build terraces and buildings with rammed earth. To this class of buildings, no doubt, belong the Casa Grande ruins, Arizona In 1632 this ruin was six stories high and the Government is now preserving what remains of it. The Indians at that time had no legends as to who constructed it. To many it is a puzzle by what method the Casa Grande was built. But the markings of pisé forms can still be seen, and we are sure at least, that that method was used in its construction.

Walls Hard as Stone

To us it is of more practical value, however, to find that some of the early colonists knew how to build with rammed earth. One of the oldest houses in America is a building of this construction in St. Augustine, Florida. It is established that it was built in 1556. Another old pisé building has been found in Washington, D. C. According to preserved documents it dates from 1773. A few years ago the present owner of this house attempted to wreck it, needing the space for a more modern building. The wrecking had to be given up, however, because the walls were found to be as hard as stone. It would be an expensive process to completely demolish them. So, the house was remodeled and the exterior refinished with white pebble dash

Similarly constructed buildings are said to exist at various places in the south, or where the colonists had come from pisé-building provinces in Spain or France. Thomas Jefferson knew of the method and recommended its use, and it is thought that some of the old farm buildings near the Jefferson home in Virginia are so built.

A Way to Lower Building Costs

In our April 1924 issue we described the revival in America of the art of building houses out of ordinary earth—the so-called Pisé method. A large number of inquiries came in requesting more particulars. These were referred to Mr. Karl J. Ellington who has had much to do with introducing this method into the Scandinavian countries and is the one responsible for its revival here. He tells here of the development which our first article predicted.

We are convinced that when Americans are more generally informed as to the virtues of the Pisé method, there will be springing up all over the country attractive homes, built well within the means of the average citizen.

The first studies and experiments were made in this country many years ago, but only a few hundred inquiries and very little building resulted up to 1920. Just after the war the writer happened to be visiting in Europe, and introduced the method into the four Scandinavian countries. In Sweden and Norway now are to be found fine residences and even factory buildings as far north as the polar circle. These buildings have stood the severe winters up there for many years and prove that a pisé wall is practically as good under the midnight sun as on the equator, so far as its wearing qualities are concerned.

This revival in Europe has been mentioned occasionally in newspapers in America and a few individuals became interested and sought more information on the subject. Some two thousand inquiries have been received by the writer from all parts of the country, while several hundred have already made the first venture or are now building. Notable among these are a beautiful and luxurious home in Kansas City and a fine residence in Washington, D. C., of which we give a photograph. In Rockford, Illinois, is a small house that is so successful, work is now proceeding on a dwelling house. Another successful building is in Newcastle, Indiana. In Brunswick, Minnesota, a small house was built last year and a larger one is being erected this year—all by the pisé method.

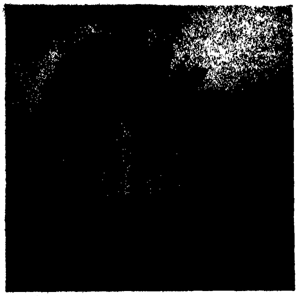
Good for Hundreds of Years

Several hundred settlers and farmers in Canada are also building with rammed earth. They usually start with a chicken house, garage or barn and build the living houses after having more facility in handling the material. In every case the trial building has been so successful that large buildings follow. In the adobe-building states, many home builders are finding the pisé method far superior to the old way both as to time saving and the final result. On the Pacific Coast many are preparing to build this summer. The method and material harmonizes well with the architectural traditions grown out of the early Spanish culture in these parts, with its missions and haciendas, and occasional touches borrowed from the venerable pueblo creations.

That this type of house is the most healthful kind to live in, can be abundantly proven to anyone who will care to investigate or listen to the evidence. The investigator will also find that such a house will remain good for hundreds of years—practically

FOR A SMALL OUTLAY IN CASH

this henhouse was the sensation of Kanabec County, Minnesota, last year. The curious traveled miles to see it and many similar "coops" were patterned thereafter



A GOOD TYPE TO START WITH

The first attempt at pisé building is usually a structure of this kind. When facility is attained, larger buildings follow

THE OWNER BUILT THIS HIMSELF

To build this bungalow at Costa Mesa, California, dirt from the cellar excavation, with barbed wire reinforcement was used upon a concrete foundation

indestructible; that in fact the rammed earth wall will become stronger and harder with greater age, owing to the chemical action of weathering. As for foundation, many architects regard basements as an old-fashioned extravagance, and many a housekeeper has found running up and down stairs to and from the cellar an irksome part of the day's work.

A Cellar Above Ground

In building with pisé we have one more good reason for discarding the old style basement, since the best kind of a cellar, if wanted, can be built above ground and conveniently located near the kitchen or even connected with the same. In this way the rammed earth wall also obtains minimum cost even for the foundation, for in some localities there will be natural stone near at hand to use, and a little cement will be needed on top only, on which to spread the damp-proof course. Thus, the expense of excavation will be eliminated.

It is of importance that this method be taken up by farmers and settlers. There the conditions are most favorable for getting buildings at very small outlay in cash. Whatever will reduce the farmer's expenses will enable him to sell foodstuffs at lower prices. Lower building costs will also help many young men to choose farming instead of the city. Next to farmers and settlers, all people who want to live in suburbs or in country homes ought to know how to build their homes with the soil on the building site.

Our pisé house is not only cheap to build, healthy to live in—cool in summer and warm in winter—money-saving as to upkeep, fuel, insurance, doctor's bills, and so on, but it is also a house that will last forever, and, if built right, will withstand even the severest storms and cyclones. This, of course, is an important consideration in our middle western states —Ohio, Kansas, Nebraska, and so on.

Great Saving in Maintenance

If it were commonly known that the very best kind of dwellings and other buildings can be built with rammed earth, and if the method were utilized wherever conditions would warrant its use, it would mean a saving of millions every year in reduced building costs, maintenance and insurance. And this is only the financial side of it. It would mean to have at hand a building system that would enable every American family to live in a home of its own, without a cloud of debt overhanging. This freedom from obligation to the rent man would contribute much to the happiness of independence-loving Americans.

That by this method a house can be built at much lower cost than with any other material is self-evident, since the soil to build with, is already on the building site and free of cost even for freight. This soil requires no special treatment, and the implements needed—a movable form and three rammers—can be made by the self-builder in his own yard.

A good demonstration of the utility of pisé on the coast is a bungalow recently built in Costa Mesa, California, a photograph of which we give. This building is thirty feet by twenty-nine feet with five rooms and bathroom, also hall and porch. The owner is not a builder by trade and knew nothing about it except what he learned from the book, "Modern Pisé Building." No other help or guidance was needed. The method is for self-builders. There are a hundred details to be observed and none of them can be ignored, but they are all easy to understand. Any man with ordinary intelligence can follow them and do as well, but no one should attempt to build with rammed earth with fragmentary information, for pisé building is as much an art as any other method of building, and many of the seemingly fine points are essential to complete success.

Opens Up Unlimited Possibilities

The writer has a pisé home, now under way. The cellar will be above ground near the kitchen. For smoke channels, drainage pipes rammed into the walls make brick and masonry superfluous. Rammed earth will be used for the floors with open space between the ground and the floor, so it will be completely dry. Round pillars of great strength and some other stunts in pisé are features already tried out. The next experiment will be a good, tight and cheap roof made principally of compressed soil. Here there are a few problems in stresses that must be solved.

Pisé building opens up unlimited possibilities and, though it has passed the experimental stage, there still remain numberless effects of architectural beauty and utility to be perfected.

FORMS USED FOR BUILDING WITH RAMMED EARTH

The author stands in the right foreground directing construction of a demonstration building

LIKE ANY OTHER MODERN TYPE OF HOME

A completely modern house recently constructed in the suburbs of Washington, D. C.

Ewing Galloway

A VIEW OF THE OLD KIMBERLEY MINE, SOUTH AFRICA

This mine has been worked to a depth of two thousand feet The great open pit would hold a mountain

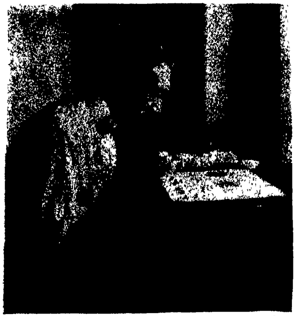
The Art of Cutting Diamonds

How the Rough Stone Is Cut, Sawed and Polished to Produce the Most Brilliant of Jewels

By Albert A. Hopkins

NOT so very long ago, we read in our old geography text book the sentence, "Amsterdam is noted as the center of the diamond-cutting industry of the world" The statement is true no longer. To-day, America leads the world in the value of diamonds cut within her borders, and of all her cities New York glitters most brilliantly with these precious stones of her own cutting

It has been estimated that all known diamonds represent a value of five billion dollars In other words, these stones approach the value of all the gold accumulated in the world, which amounts to something less than eight billion dollars.



GETTING THE STONES READY FOR CUTTING

Before the diamonds are split or sawed the stones are marked to show where the cuts should be made

Most of these diamonds come from South Africa, about ninety million carats having been mined there. Brazil has produced fifteen million carats, southwestern Africa, five million, and India two million The total output of all the other diamond-producing countries is less than two million carats. Dr George F Kunz, a gem expert of international reputation, estimates that the total production of the various diamond fields is a little less than one hundred and fourteen million carats.

Cutting a Highly Skilled Art

Naturally, the diamond in its rough state is useless except for technical purposes. It must be cut and polished with the highest degree of skill before it can take its rightful place as the queen of jewels. Early in the history of the lapidary art Amsterdam acquired a monopoly of the diamond-cutting industry, a monopoly she held until recently. The cutting of diamonds is a highly skilled art, difficult to learn, and mistakes made in cutting are extremely costly. Few skilled cutters were to be found outside of Amsterdam. With the World War, however, traffic in precious stones in Holland was seriously interrupted. Added to this was the rapid increase in the use of gems in the United States. What more natural than that the stones should be cut here? For a long period experiments were carried on in a small way, but larger wages offered in this country were a powerful inducement to highly skilled European workmen. Of late years, the industry has grown swiftly and to startling proportions.

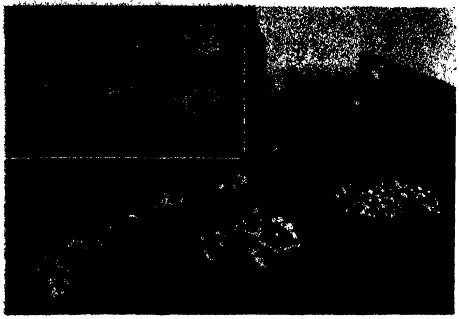
Each diamond has its own peculiarity; and each one must be dealt with individually to bring out its particular merits. The diamond is too precious to be wasted in experiment. The cutter must exercise wise judgment based on long experience; for an unskilled workman may ruin a valuable stone.

"LOPPING" OR PUTTING ON THE LARGE FACETS

This step in the process is performed by the revolving disk or lap, which is charged with diamond dust

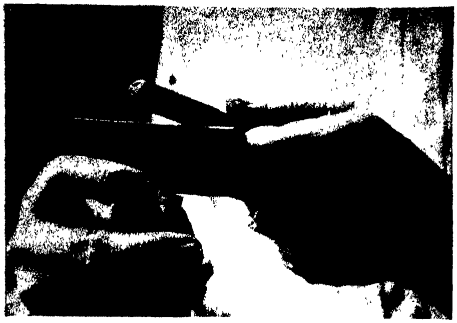
Before cutting, a diamond is given a close and critical examination to determine into which one of the recognized forms it can be cut to the best advantage. Upon the decision depends largely the profit to be made on the stone. Sometimes it is found that a large diamond of excellent quality contains several minute flaws which must be eliminated Only an expert can determine how the stone should be divided to get the best results.

When he has made his decision, the examiner indicates by little scratches where the stone is to be cut. It then is passed to the "cleaver," who divides the stone by sharp blows on a steel blade This process, too, requires wide knowledge of the forma-



ROUGH DIAMONDS AND THE PROCESS OF CUTTING

Twenty-five thousand dollars worth of uncut diamonds. The insert shows the successive steps in the process of cutting and polishing



CLEAVING THE DIAMOND

After the stone has been marked for cutting, it is divided along the cleavage planes with a steel knife. A sharp blow is all that is necessary to split it

tion of diamonds, for while they can be split easily on the proper planes of cleavage, they may be ruined if the tool is applied improperly.

Not only is the stone divided into the desired parts by the splitting process, but much of the superfluous material and the parts containing defects are removed by the same operation. There is still another shaping process, however, through which the stone must be put to bring it approximately to its final form. This is sawing, a process used widely in this country.

In sawing, the stone is first fixed in a holder by imbedding it in a small mass of lead in the end of the tool. Thus mounted, it can be held against the saw, which is a small disk of phosphor-bronze exceedingly thin and revolving at great speed. There are no teeth on the saw and it makes no impression unless its edge is kept charged with diamond dust mixed with oil. As the stone is slowly cut, every particle of waste material, both from the splitting and from the cutting is carefully saved for diamond dust for use in sawing and other operations; for the diamond is the only thing which has been found which will cut another diamond. The operation of sawing involves a high degree of technical knowledge and, in fact, is often carried on as a special trade within the general trade of diamond-cutting.

Sawing reduces the stone only roughly to its final size. To finish it and produce the many glistening facets, sometimes as many as fifty-seven in a well-cut brilliant, the stone must be cut or polished. For our drawing showing the sequence of operations to the stone we are indebted to Mr. A. T. Hunt, of J. R. Wood and Sons. Formerly, this was done by mounting two stones in separate holders and patiently rubbing them together, the two faces smeared with a mixture of oil and diamond powder. Now, however, the work is done on a horizontal iron wheel which revolves rapidly and upon which the stone to be cut is pressed by means of the holder. The cutting wheel is charged with diamond dust. Even with this mechanical aid the process is slow and requires great patience. The cutter relies entirely upon his eye and a false move would quickly end in disaster. The cutting of a single stone is the work of several days. The greater the number of facets, the greater is the danger of the stone being damaged in the workman's hands.

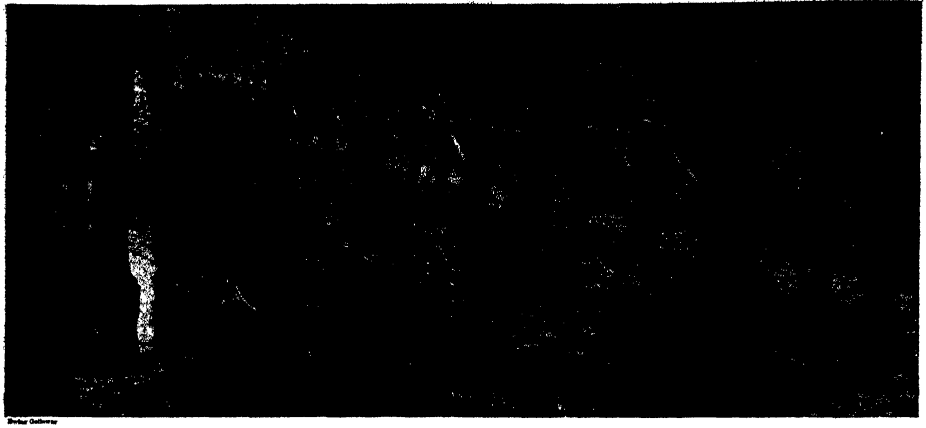
The sequence of operations is shown in our drawing. First, the rough diamond is sawed or cleft; then it is cut or shaped, then lopped to make it four square, then lopped again to make it eight square, and finally "brillianteered" or finished by putting on the small facets, when it is ready for its setting in gold or platinum.

In the process of cutting, about sixty percent of the weight of the rough stone is lost. The cost of cutting and the rarity of really fine gems in the rough account for the high price of the finished diamond. Weight often is a poor criterion of the value of a diamond, since the purity of the stone and the skill exercised in its cutting are what count most.

Diamond-cutting is an industry which not only requires great skill but it is of ancient and honorable lineage. Although it now centers in New York City, Amsterdam may still take comfort in the thought that a considerable number of the diamond cutters in the United States are native Dutchmen.

DETAILS OF CUTTING—FROM SHAPING THE STONE TO PUTTING ON THE SMALL FACETS

Left: *This is a diamond cutting another diamond. One is in a lathe, the other in a holder.* **Right:** *Diamonds are cemented in a "dap" or holder preparatory to cutting.* **Upper Insert** *Brillianteering or putting on the small facets which are produced on the revolving lap*



Ewing Galloway

The Carolina Wren

This Happy, Optimistic Mite of a Bird Is a Musician, Architect and Artisan

By S. F. Aaron

THE early naturalists in America, as in no other countries, were woefully twisted in the matter of names, thus giving the nature observers of later generations some cause for complaint Not only were absurd appellations used in imitation of Old World names, as, for example, the names robin, partridge, pheasant, quail, panther, adder, and so on, but also such erring terms as make us think of restricted habitats Thus we have the term thrush applied to warblers and warbler given to many birds that do not warble and for widely distributed species, such titles as Maryland yellow-throat, Kentucky, Tennessee, Nashville and Connecticut warblers, Louisiana heron, English snipe, English and French mocking-birds and Carolina wren

•

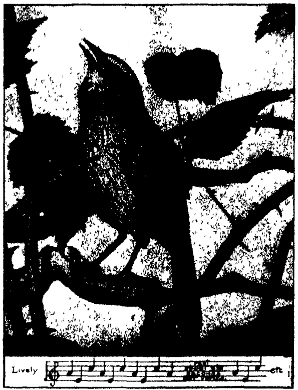
Not Native to Carolina

The Carolinas have no more right to be honored with the name of this little songster than have any other states south of Middle Pennsylvania and New Jersey, Southern Ohio, Indiana, Illinois and Iowa, the range of the species not extending far west of the Mississippi River, but all over the eastern, southern and mid-southern United States. Added to this misapplied appellation is another specific misnomer The systematist Gmelin, having received specimens solely from Louisiana, called the species *ludovicianus*. Although Wilson, ignorant of Gmelin's work and falling into the more common error, had named the bird *caroliniana*, Audubon, Nuttall, Bonaparte and subsequent students up to the present day must follow the prior naming.

Then, as though not content with the extent of these absurdities, Viellot wished to put the unoffending little creature into another genus, calling it mistakenly a leaper of reeds, *Thryothorus* This name was rejected for a time, although it is now admitted, so that, if we wish to be accurately specific in a universal understanding, we refer to the bird as *Thryothorus ludovicianus*, the reed leaper of Louisiana Sometimes one must incline to the beloved Burrough's idea that scientific names are uselessly cumbersone and often misleading.

It is not less amusing to note the variations in the descriptions of the species. Wilson and Audubon called it the Great Carolina Wren and gave its length as five and one-quarter inches. Coues and Jordan leave off the "great" and note the length of the bird as six inches. The United States Government Bulletins and Ridgway give it as five and one-half inches

It is likely that most bird lovers have their favorites among these feathered friends that are at least better understood. Thus, I have heard some select the intrepid little hawks; some the wood thrush, solely for its musical ability. Others choose the kingbird or the shrike. I know one intellectual student of birds that most admires the crow.



All drawings by the author

THE SONG OF THE WREN

This drawing shows the singing attitude of the Carolina Wren. These birds sing also when they are fighting

The father of American ornithology probably favored the bluebird more than any other, as did Burroughs, Maurice Thompson chose the mockingbird. From their complete writings one might infer that Job would select *some* of the sea birds, that Chapman most favors the veery, that Stone could grow moderately enthusiastic over the purple martin, that Ridgway's favorite is the western meadowlark, that Spencer Baird loved the thrasher and that David Starr Jordan very possibly agrees with the poet Bryant in his admiration of the bobolink. Others, such as Audubon, Nuttall, Brewer, Maynard, Samuels, Coues and Bendire express no preferences.

Possesses Remarkable Vocal Powers

If this deponent may have a feathered favorite, one of truly heroic mold and one that is worthy of the greatest admiration for its abilities as a musician, architect, artisan, its happy, optimistic disposition and its domestic virtues, then none other than our little friend, the Carolina wren must be named.

I confess that the barn swallow, with its excellent nest building—combing masonry, basket-work and mattress making—its cheerful twitter, its poetry of motion on the wing and its well managed family affairs reaches a close second, easily overtopping all but the voluble, intrepid, ever-happy, sprightly, amusing, more than active, thumb-sized gleaner in hidden places, the Carolina wren.

First perhaps is the song. And who, loving all that is beautiful, can fail chiefly to note it! This little bunch of flesh and feathers, which, with the feathers picked off is no larger of body than a shrew, is most remarkable for its vocal powers. A certain sweetness of tone might be expected, from the fact that it is a wren. The loudness of its notes may also be explained in part as a matter of heredity. But even that cannot anticipate the wonderful volume of sound that comes from the throat of this mite. It is probably one of the loudest bird songs of any kind to be heard anywhere and it comes from one of the smallest of the warm-blooded, back-boned creatures in existence. How, without splitting its larynx, shattering its palatine bones and jarring its entire system to the point of sudden dissolution, it can emit such high-pitched and penetrating vocal efforts is beyond understanding. How such tiny lungs can get sufficient force into sounds that sometimes can be heard for over half a mile and are always believed by the listener to come from a creature ten times the size is hardly to be comprehended.

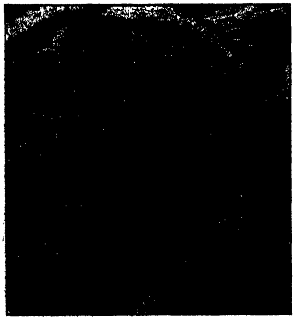
If one may find even a poor excuse for putting bird songs into words, the Carolina wren's commonest utterance may be written: *weet-so, weet-so, weet-so, weet-so,* the eight or ten syllables given rapidly and repeated about ten times a minute. The second syllable of each note is higher pitched. There is also heard, and perhaps as often, a decidedly different pronunciation which may best be likened to *tootle-tootle-tootle-tootle,* the last syllable lower. Sometimes the notes are pitched so that the highest one is about middle C on the piano; at times, especially during the breeding season and when the birds are fighting, there is greater rapidity and more than half an octave higher is reached without, of course, any particular key being chosen.

Sings All Through the Year

Fully as remarkable is the fact that this small bundle of energy sings all the year round—on the hottest days, far into the fall, often on the coldest, windiest days of winter and more often when a bright sun slants upon a world of wind-drifted snow. This habit, shared only by one other of our avian fauna—the mocking-bird—is positively demonstrated in the wren's southern habitat, but also, although less frequently, in its more northern haunts.

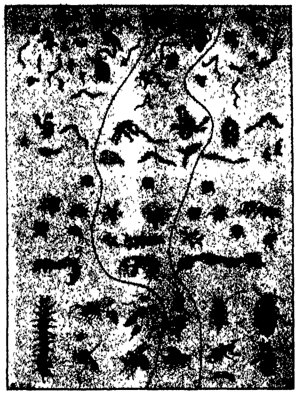
Penetrate thicketed patches, covered deep by the Frost King's mantle, and the most cheery call you will hear, nearly the most musical in any season, will be the far-flung, three-syllable song of the Carolina wren. It rings out through the frosty air, a veritable beacon of sound, at delightful odds with the wintry surroundings and the landscape and like unto nothing that we may expect, each time a surprise even to him who has heard it before.

Among bird lovers, Audubon showed the greatest appreciation of the Carolina wren's song. With his not unusual exaggeration he ascribed to it mimicking sounds and named the bird also the "mocking wren," but there is not the least reason to suppose that the notes are meant to imitate other sounds of any bird; not even the bird's musical trill of alarm nor of self-communion is like that of any other bird or animal.



NEST OF THE CAROLINA WREN

The exterior is entirely of twigs and small roots. It is placed in a large brush heap in the woods



CONTENTS OF STOMACHS OF WRENS

LEFT. *Bird shot in April.* CENTER. *Bird shot in June.* RIGHT. *Bird shot in October. Ants, spiders, caterpillars and a miscellaneous assortment make up the bulk of the food. Much is difficult to identify. Comparatively indigestible parts, such as the heads of caterpillars, remain whole longest*

The Carolina wren earns also the unique distinction of being, among passerine birds, the only non-migratory species inhabiting temperate eastern North America. I have given the closest observation to a number of these birds of both sexes and to definite pairs nesting in certain localities and not once have I failed to note that individual wrens, told by certain definite characteristics, remained in or near the neighborhood where they nested, perhaps traveling half a mile or a little more along lines of hedges and thickets to insure well-filled stomachs.

At this time I know of three pairs of Carolina wrens each of which have inhabited sections of a few acres in extent, one an old mill site, the other pairs in patches of thicketed woods and for five years they have strictly adhered to their chosen locality. I am only at a loss to know what becomes of the young of two broods each, aggregating thirty, successfully reared each season. No doubt there is a large mortality among them, especially from hawks and shrikes; that they do journey away is certain, but how far?

The nests of the Carolina wren differ little from those of other species of the same family, except that the former are not attached to reeds like those of the marsh wren nor are they constructed within such restricted spaces as those chosen by the house wren. Placed in rocky chinks and crannies, in dense masses of brush and thickets of broken-down briars in holes made by the rotting limbs of fallen trees, always out of the reach of such larger enemies as the squirrels, the fair-sized snakes and even the short-tailed shrew, the birds need fear only such smaller reptiles as the garter and ribbon snakes, more rarely the long-tailed shrew, which creatures they combat with such fury as often to defeat them.

I have examined more than forty nests of the Carolina wren, mostly in the mid-southern states, some in Pennsylvania, Delaware and Maryland and have always found them as above described. A bulletin of the United States Agricultural Department asserts that they are sometimes placed in vines, but I have never seen them in such situations. There is a great variation in the material chosen, and this variation is not geographic. Two nests in Tennessee, placed as close together as the rivalry between the males would allow, were built in the manner most commonly employed: a rounded mass with the entrance hole near the top of one side. And as usual the insides were lined with feathers and a downy stuff plucked from some unidentified vegetation. But the outside of one nest was made entirely of coarse sticks and twigs, some short pieces being almost as thick as a lead pencil, while the exterior of the other nest was solely of fall grass, sometimes called horse grass—possibly because horses will not eat it.

Not even the nest of the ovenbird, the meadowlark nor of Mrs. Bobwhite can equal the sheltering compactness and mass strength of the Carolina wren's nest. The female does it all, but should her lord and master, who is often woefully henpecked, dislike the situation for any reason—and such is frequently the case—he will build a nest of his own in which, at times, he may roost. This nest is generally quite superior to that of the female, being more bulky, better put together and softer inside, but invariably, I think, she turns him down, occupies her own mansion and the little ones are reared therein, being fed also by the paternal hustler. The wren-like agility of both parents, surpassing perhaps almost any other bird even of its nearest kin, insures an abundance of nourishment to the young, who fly in about two weeks after hatching.

Its Food Mainly Noxious Insects

The contents of the stomachs of birds have been carefully studied in Washington, the averages being quoted as very representative. In my own observation of those birds of the species, shot for museum specimens, the general menu holds much alike in all, with some differences in percentages of species. The busy little gleaners get those insects that frequent the places where the wrens seek shelter; thus spiders, ants, barkflies, ground beetles, black crickets, cave crickets, the caterpillars and chrysalides of moths and those arthropods that crawl into lowly places to hibernate, naturally compose the bulk of the bird's food. Some of these creatures, such as spiders and certain rapacious insects are beneficial, but it is safe to say that the majority are noxious species. Thus the economic value of the Carolina wren is assured, and, since this is the case, every effort should be made to protect it.

ANOTHER NEST OF THE WREN

This nest was found in a scrap lumber pile. In contrast to the other, the exterior is made of grass

From the Scrap-book of Science—C nera Shots of Scientific Happenings

Kadel & Herbert

THE MECHANICAL TRACK INSPECTOR

Oscillations and jolts due to imperfect railroad tracks, register themselves automatically on a roll of paper moving through this device. Separate records are taken of up and down jolts, sidewise jolts and lengthwise jolts. After a run it is possible to locate any given defect which has left its record

Pacific & Atlantic

HOW BLOW THE WINDS ALOFT?

A hydrogen balloon is being released while an observer stands nearby with a theodolite, ready to follow its course as it rises and floats down-wind. Some of these balloons have gone as high as 90,000 feet. By following them with these instruments it is possible to determine the velocity of the wind at various levels. This information is of great value to aviators

Kadel & Herbert

THE BUSHMAN'S CANDLE

If you light the stems of this plant they will burn like tallow candles. The plant grows in the deserts of South Africa, a region formerly inhabited by large numbers of a primitive negroid race known as Bushmen. Hence the plant's name

Kadel & Herbert

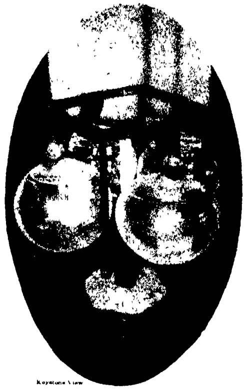
A LOAF, OR A STONE?

This South African plant so closely resembles a stone that it is hard to distinguish from a stone. It is composed largely of water and provides a welcome thirst quencher for both human beings and animals. In the foreground is a real stone

Henry Miller

"SEEING" THE BANG OF A GUN

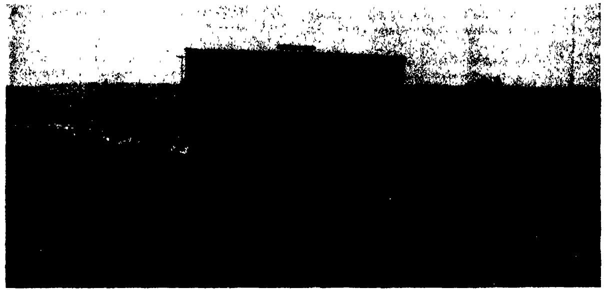
This is the muzzle of a .45-caliber revolver just before the bullet has emerged. The round, black curve that shows is the primary sound wave, photographed by the United States Bureau of Standards. Sound waves are local condensations of the air. This fact enables them to be photographed, since light is differently "bent" as it passes through these areas of greater or less density



Keystone View

HOW OLD IS "DIFFUSED LIGHTING?"

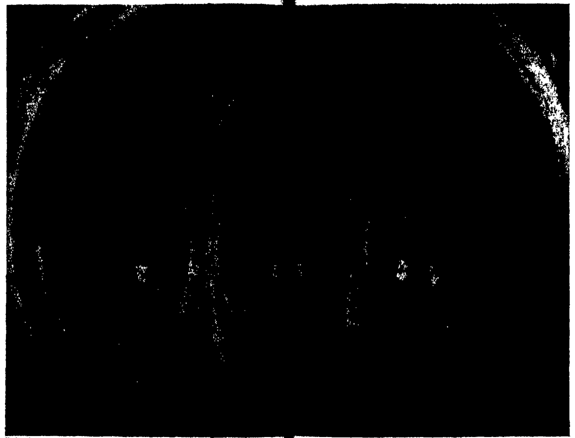
We have heard much about the recently discovered value of diffused lighting. Here, however, is a cobbler's lamp of the Middle Ages. By placing a candle between four globes of water the light was diffused in a crude way. This was given to Dr John Finley, when he last visited France



Pacific & Atlantic

PROVING AN OLD MAXIM

The old maxim that the early bird catches the worm is surely true in this case. The sea gulls meet the plowmen every morning at sunrise and the most active of the group quickly get their fill and depart. This picture shows a plowman and birds near La Jolla, California



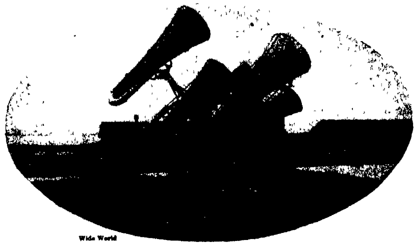
Ewing Galloway

HOW NEW YORK GET S DRINKING WATER

The interior of the concrete-lined tunnel which carries w from the Ashokan Reservoir in the Catskills to New York City—the world's largest and most expensive municipal system. The three channels are for siphon connections. Steel siphon pipes, buried well below th face, take the water across low valleys

TRUCK TANK UNDERGOING FIRE TEST

Severe tests had to be passed by this gasoline truck tank before New York City would permit its use in the streets. These tanks were barred until recently, owing to such possibilities as that of gasoline in large quantity running from them into subways and being ignited by sparks



Wide World

WHERE IS IT?

Trying to locate airplanes that can be heard but cannot be seen. The Army has been developing this sound-ranging apparatus as an aid to the human ear. With our ears we judge direction of sounds by combining the impressions received in the respective ears. Above is a battery of super-ears, which may be turned in all directions

Pacific & Atlantic

EXPANSION OF PRECIOUS STONES DETERMINED

G. E. Merritt, expert at the U. S. Bureau of Standards, looking into a blazing furnace where diamonds and precious stones are heated to certain temperatures to note their expansion. The Bureau of Standards has been cooperating with the makers of dishes, telling them the best way in which to make them so that hot foods will not expand them unevenly, thus causing them to break

Fotograms

EAGLE-EYE FINGERPRINT CAMERA

For photographing fingerprints, George Blum, official photographer of the San Francisco Police, has invented a special camera, that does the work perfectly. The camera is equipped with six small electric lights, placed in front of the lens, no other light being necessary to make the photograph. It also has attachments for the use of ray filters, when it is necessary to register color

International Newsreel

EGGS OF EXTINCT REPTILES

The third Asiatic expedition has returned from Mongolia with new finds of animal life. A closeup of the contents of the nest of the 100,000,000-year-old dinosaur eggs. These eggs are about eight inches long and the fact that they were dinosaur eggs was determined by finding the embryos of tiny dinosaurs in some of them

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

Egg boiler made of wire

Safety on the road furthered by anti-glare lamps

Line rings for tools

Babcock tester with cover removed

Egg-Cooking Device

EVERY housewife will appreciate this latest novelty for the kitchen. It is an egg cooker, server and detector From one to six eggs may be boiled in this device at one time. When they are taken out of the water, they may be served on the table in this cooker Spoiled eggs may be detected when boiling, because they will float out of the separate holders

Anti-Glare Auto Lamps

THESE new automobile anti-glare lamps will undoubtedly eliminate many auto wrecks which result from the deadly glare of an oncoming car. They come in sets, two to a car One lamp is placed on the fender on the left side of the car focused to the rear. The other lamp is placed on the right fender and is focused to the front of the car The lamp on the right gives full vision of the road ahead and the one on the left gives the oncoming car behind a light on the road

Safe Lowering of Tools

IN almost any industry, and particularly in the electrical trades, it is often necessary to raise or lower a tool to a workman. Throwing tools from an elevation has resulted in thousands of serious accidents The Detroit Edison Company has solved the problem by attaching rings to the various tools so that a line may be secured to the ring. The tools can thus be lowered or raised with safety to the workman and without endangering the passerby The device is very simple and is strongly recommended Danger from falling tools will be absolutely eliminated by this very simple device

Motor-Driven Babcock Tester

THE Babcock cream tester has now been provided with a motor which adds to its speed and efficiency It is also arranged so that it can be driven by hand power The bowl is made in two separate sections, the upper half of which may be removed easily for inspection and cleaning. There is an opening in the cover for inserting and removing the bottles being tested, without removing the cover.

An English Innovation

FROM the Olympia show in London we illustrate a car equipped with a compact tool chest built into a panel of the door.

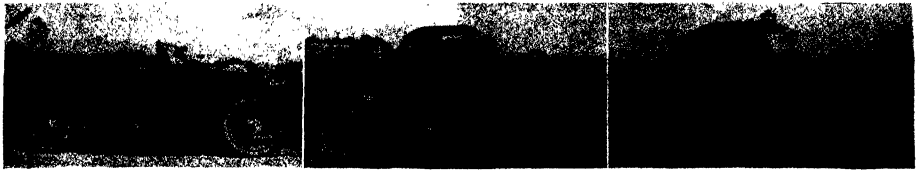
A tool chest built into the door of an English car

A Shiftable Top for Automobiles

THE top is of rigid construction and is shiftable by hand to and from a position resting on the rear deck. Counterbalancing springs carry the dead weight of the top so that no appreciable effort is necessary to effect the shifting operation. This type of top structure allows the car to be changed in a moment from an uncovered roadster to a weather-tight coupe. Door windows rack up and the quarter windows quickly clamp into place. These latter windows are housed in a compartment back of the seat when not in use. A movable panel in the top allows use of the deck seat when the top is lowered. The top consists of an ash frame, padded and covered with water-proof fabric. It is securely clamped in either position so that no shake or rattle is possible With the roadster increasing rapidly in popularity as the sport type of car, this top construction is interesting because it offers an improvement needed in the roadster, namely, a top which is easily lowered or raised and one which will not lose its appearance by repeated lowering. Furthermore, the fact that the car is quickly made into a snug coupe if the weather becomes inclement is decidedly advantageous

An English "Safety Line"

A REMARKABLE form of white line is now under test in London In the center of the North Circular Road, say *The Engineer*, an illuminated line over 30 feet long has been laid. The "line" is contained in a wrought iron trough sunk to the road level. In the trough are electric lamps, and the trough is closed with alternate sections of reinforced white marble and prism glass. Thus the line is visible both by day and night. The lighting up and extinguishing switch is controlled by a clock.



This top is of rigid construction and is shiftable by hand from a position resting on the rear deck to the positions shown in the illustrations

Safety for baby's bottle

A Bumper for the Baby's Bottle

BOTTLES are apt to fall from baby hands and break. This rubber frame for them affords protection against such accidents, because it provides an anti-skid grip for little hands. A bottle thus protected will not break, nor will it roll out of reach. The frame need not be removed when the bottle is washed.

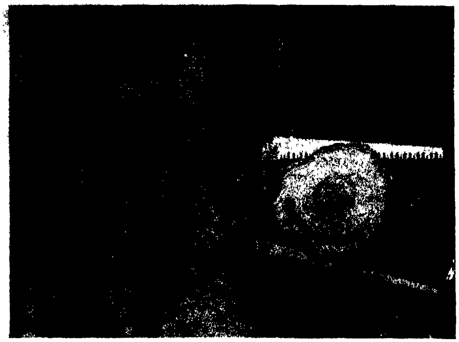
An Improved One-Man Saw

AN improved hand tool which is being used by a number of telephone and public service companies, though designed for the farm, is shown in the illustrations. *Some of its advantages will be readily seen.* It will do the work of a two-man saw, without making it necessary for the operator to stoop. It folds compactly for transportation, has a spring tension that feeds the saw according to the strength of the operator, in any position desired; and it is moderate in price. The principle on which the saw works is based on the operation of a pressure bar. A steel coil spring connects the pressure bar to the handle and operates to keep the saw pressed against the log at all times, causing the blade to cut as efficiently on the return stroke as on the forward one, and without increasing the labor of the operator. The spring is adjustable so that the pressure can be regulated to suit the width of the log to be sawed. The tool consists of a strongly built frame of the best steel tubing with all joints brazed and a saw blade of finely tempered rolled 13-gage saw steel. The saw teeth and rakers are of special design, determined by years of actual experience by R. W. Graves, a Canadian woodsman, the inventor of the saw.

A Box Without Bolts or Rivets

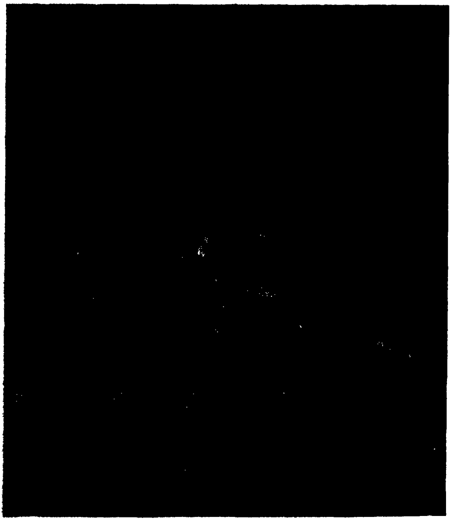
THE carpenter's box which we illustrate is welded throughout, so that there is an entire absence of rivets or bolts.

A welded carpenter's box



Cutting a twenty-six-inch cherry log with a one-man saw. Notice the spring tension that feeds the saw

A booster for the grease gun consists of a small metal unit producing extra pressure, particularly in case of clogged or tight bearings



A one-man cross-cut saw machine

A cap that can be pried off and resealed

An Easily Removed Bottle Cap

TO open this new bottle it will be unnecessary to search for a bottle opener or for a handy nail on which to rip off the cap. The rim of the bottle is constructed in such a manner that a ledge guides the blade of the opening medium upward so that it comes in contact with the crown cap without striking the glass locking rim. A coin, key, knife, or any flat piece of metal applied under the edge of the cap and twisted will remove the cap without any mutilation, and the reseal value of the bottle is preserved, for the cap may be put on again and it will be tight. In the use of this new device it is claimed there is not the danger of chipped bottles which is common to other types.

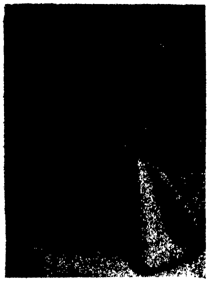
Greasing the Auto

A SMALL metal unit which can be readily attached to any grease-gun by means of a screw thread is of great assistance in greasing the auto. The extra pressure on the grease is produced by a piston operated by a very fine screw thread. A handle on the outside permits of the booster being operated by a few turns of the fingers—raising the pressure from an average of five hundred to five thousand pounds. This is a great advantage in cases of clogged or tight bearings which resist the pressure of the ordinary grease-gun.

A Handy Rod for the Angler

WITH a locking device the guides of the fishing rod shown on this page are kept in perfect alignment. The caps, when screwed down, lock the joints in position; and they cannot creep out of position, even under the heaviest use. The ferrules are not depended upon to hold the sections together. Our illustration shows the butt section about half way out of the handle. It also shows the notch in the handle part and the section which, when held together, prevents twisting. To insure against rusting from the inside, each section is covered first with a rust proof priming coat, which is baked on, and then with two coats of tough, glossy, baked enamel.

Lock-jointed steel rod



Loading anchor for automobiles

Side view of the anchor

Metal Loading Anchor for Automobiles

THIS new anchor for automobiles cuts down the labor and assures safety The construction is clearly shown by the engravings There is no danger of the anchor injuring the tires, because the machine is suspended from the hubs The metal anchor is very durable and is for this reason superior to one made of wood, which is only good for one trip

"Dryice"—a New Refrigerant

UNDER this name a very useful preparation is now being marketed The name is a trade mark and stands for solidified carbon dioxide gas It turns to a clear dry gas without giving out a liquid Physically, it resembles a cake of well-packed fine snow, harder than water-ice and nearly twice as heavy It is shipped and used in a paper wrapper. This product makes it possible to buy ice cream on the way home from the office and consume it six hours later A disk of dry ice wrapped in an insulating compound is placed in the container first, then the ice cream Our engraving shows a store window in Boston with the product displayed There is no danger of drip because when the ice wastes away it is in the form of a gas. "Dryice" is most efficient for refrigerating show windows, a job which has always been difficult with ice-encrusted pipes

"Dryice" is really solidified carbon dioxide

Taking Shot from the Soil

WITH a new invention, a specially constructed sluicing machine, Charles Loveridge and A E. Cox are attempting to clear shot from the ground on which the Portland Gun Club, Oregon, has been shooting for years The field has been plowed several times, and the ground to a depth of ten inches is filled with shot From the dirt that clung to the roots of an old corn shock, a tablespoon of shot was panned; and four hours' work with the sluicing apparatus over a surface measuring about six by twenty feet yielded six hundred pounds It is estimated that there are about one hundred tons of shot to recover. Probably other gun clubs could use the machine to advantage.

Taking shot from the soil

A Mechanical Pacer

DESIGNED to revolutionize the coaching and training of track athletes, a machine called a "pacer" has recently been invented by Coach Thomas E. Jones, of the University of Wisconsin, Madison Officials claim that the device will be invaluable in teaching runners how to judge their pace. The invention, the result of four years of experiment, is merely a wooden box with a bell in it, and so constructed and timed that the bell rings at regular intervals. A runner attempting to do the quarter mile in sixty seconds will set the machine to ring every twenty seconds Every time he completes one of the three laps on the indoor track at Wisconsin he can check up on whether he is running ahead or behind schedule. The same scheme is of use in judging pacing for distance runs.

For years coaches have held a watch on their men and instructed them after each lap of the track whether to maintain, decrease or to increase their stride, but Coach Jones has invented this ingenious instrument which can be set to ring at any desired interval Experienced runners can frequently estimate within one or two seconds the time it has taken them to run a mile, gaged by their stride and the pace set Nurmi, the great Finnish runner, carries a stop watch. The same machine will be used by Coach Vail of the Wisconsin crew for rhythm in training the "Varsity 8" The machine will be used also on the outdoor track Gongs will be placed at intervals of one hundred and ten yards on this quarter mile track and wires will lead to the machine so that the dial can be set for any speed desired The device is portable.

Doing away with the coach by means of a mechanical pacer invented by a "coach" himself

The Scientific American Digest

Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

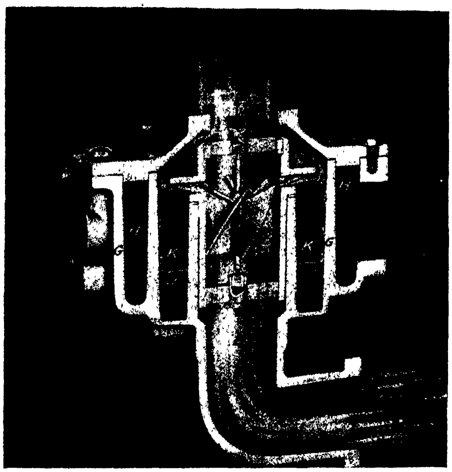
Doubling the Automobile Mileage Per Gallon

As everybody knows, the object of the carburetor is to furnish "gas" or gasoline to the motor. Gasoline being a liquid, it gets to the motor partly as a vapor (in gaseous form) and partly as a fine mist, due to the action of the jet. This latter is undesirable, as it makes a fuel of variable composition and richer than is economical. The best results are obtained by the use of a wholly gasified fuel mixed with air in the proper proportion. This is brought about, according to Augustus H Gill, Ph D., Professor of Technical-Chemical Analysis, Massachusetts Institute of Technology, by the throwing-out of the gasoline mist or droplets from the carburetor mixture, by the highly ingenious and compact attachment known as the Bursley-Trask Fuel Adjuster.

Briefly described, this consists of a bowl heated by a portion of the exhaust gases, containing a rotor with vanes curved at the top, which by centrifugal action, separate out the mist, dust, and so on, from the gasoline-charged air stream

The apparatus is attached between the carburetor and the manifold. In the sectional view, G shows the bowl of aluminum or aluminum alloy, heated by a portion HH of the exhaust gases; a portion only being used, so as not to heat the gasoline vapor too hot. The amount of heating, according to the season may be regulated by a damper K shows the pocket into which the atomized gasoline or gasoline mist is thrown road dust is also removed from the air stream and collected here. D shows the rotor in the air-gasoline stream. This is made up of six spiral blades, curved over at the top, which are fastened to a hardened steel shaft, which runs in a jewelled bearing of sapphire, with end stoned of the same This is comparable with the balance wheel "staff" and bearings of a watch, and has a similar length of life, sapphire being next in hardness to the diamond

The rotor D is set in motion by the air gasoline stream E from the carburetor. This stream moves with astonishing velocity, attaining a speed of a mile a minute. As is evident from the figure, it throws out by centrifugal force, all heavy particles passing through it. It will even separate oil from gasoline! These heavy particles (the gasoline mist and road dust) fall into the pocket K Here all the gasoline fit to burn is changed to vapor by the heat from the hot gases surrounding HH, and passes up into the manifold It will thus be seen that the device takes the heavy "ends" or kerosene-like stuff out of the gasoline The instrument practically effects a redistillation of the gasoline on the car itself, and furnishes the motor with a purer and much more uniform fuel, and one that is readily and completely combustible These "ends" collect in the pocket KK, where they are washed out from time to time together with the road dust



Details of a centrifugal carburetor which throws out all particles of foreign matter in the gasoline, preventing them from doing injury to the engine

The heavy "ends" when introduced into the motor, by the ordinary carburetor, cause the following troubles, which are too well known to every motorist 1 Formation of carbon or soot due to imperfect combustion 2 Formation of tarry matters which cement together the actual carbon above formed with the road dust, to make the familiar deposit of "carbon" This clogs the valves, prevents their seating, and grinds out the pistons, rings and cylinders 3 The heavy ends wash the oil off the pistons rings and cylinders, and prevent adequate lubrication They find their way into the crankcase and thin out the oil The road dust also mixes with the oil in the crankcase and wears out the bearings

Discussing these different troubles, we find 1 The soot formation is due to too rich a mixture there being insufficient air present to burn all the carbon 2 Tarry matters are due partly to imperfect combustion as described in 1, and partly to the heavy oils composing the heavy ends 3 The heavy ends These are at present inevitable in the manufacture of gasoline They are universally recognized as harmful, but cannot as yet be cheaply eliminated

The instrument was put on a Ford run about and operated by different drivers The method of operation was as follows The gasoline in the tank was always measured by allowing the car to stand upon a certain level concrete slab until the gasoline was still The depth in the tank was measured with the usual measuring stick, which had been carefully calibrated, giving easily tenths of a gallon The cyclometer was new, and gave readings to tenths of a mile The tire of the cyclometer wheel was kept properly inflated The car was operated in three different directions —north, south and west under as nearly identical weather conditions as possible over the same roads and at practically the same average speeds

Average of seven runs without the adjuster—19 2 miles per gallon Total mileage 373

Average of five runs with the adjuster – 34 2 miles per gallon Total mileage 236

Showing a gain of 15 miles per gallon, or 78 5 percent

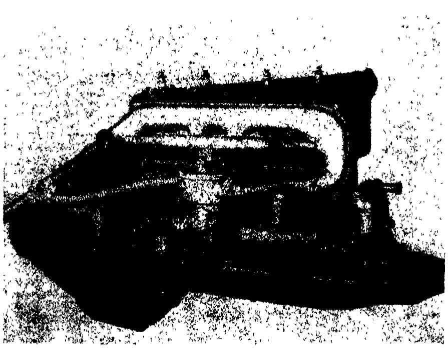
I have no doubt that in warmer weather, and under more favorable conditions, a gain of 100 percent would be found or the mileage per gallon would be doubled, which has actually been attained in one run This will hold true especially with the new and more perfectly made instruments

* * *

A Museum of Sounds

Research workers in anthropology, the science of human culture, use phonographs for recording permanent records of the speech and music of primitive peoples whom the onward march of civilization has marked down to disappear within a few generations but only since the end of the last century have comprehensive collections of records been systematically made for scientific purposes

One of the first scientific institutions to take up such work was the Academy of Sciences in Vienna which established some twenty five years ago its now well-known

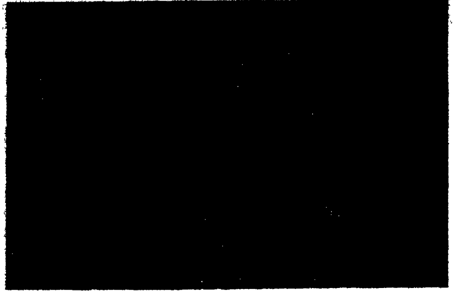


The centrifugal carburetor applied to an engine. The rotor shown in the drawing at top of page is heated by a by-pass from the exhaust

Photograph courtesy of Prof Rudolph Pöch

Making permanent records of native songs that will soon be forgotten when the inevitable encroachment of civilization absorbs a savage race

The "Green Goddess," a miniature locomotive in regular freight-and-passenger service in England. It draws ten cars at 35 miles per hour



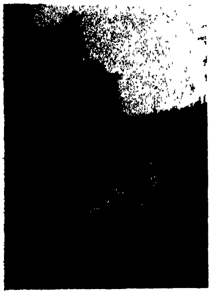
© Miss Mary O Fair

The "River Esk," a miniature locomotive, hauling rock from a quarry. These engines are not toys, but must earn their keep by work, year after year

Phonogramm-Archiv, or "Phonogram Archives."

Metal *matrices* made by a galvanizing process, from the original record are the nucleus of the Phonogram Archives They will last for hundreds, perhaps thousands of years, and they seem almost indestructible, even by fire. Today the Archives contain more than three thousand of them They have been made from records taken in all parts of the world, always under scientific control.

The records are classified into four main groups: those of philological and linguistic interest, those of musical interest, "voice portraits" of well known persons, and records of interest to students of medicine and physics. It is impossible here, of course, to give a list of all the languages in the collection, but some of the more curious ones may be mentioned, for instance, the Spanish of Paraguay, the "Spaniolish" spoken by Balkan Jews, and all the existing Celtic dialects—Welsh, Irish, Gaelic, Manx *and Breton*



A German 15-inch-gage passenger train at the recent Munich Transport Exhibition

A point has been made of securing, as far as possible, languages or dialects which are dying out. In a few years the Manx, and Basque records, for example, will be of *unique historic* value. *Another* particularly valuable set of phonograms is the collection of Sanskrit records, made in the Brahmin priest schools by the meteorologist Felix Exner while on an expedition to India in 1904.

Among the records of the speech of primitive peoples, the Archives owe those taken among the Kalahari Bushmen, and in New Guinea, to the late Professor Rudolf Pöch, the well-known *ethnographer and* anthropologist. It is of the greatest importance to science that the language of the ancient race of Bushmen, now almost extinct, has been preserved from oblivion in this way. This language is of peculiar interest, and in the phonograph records the "clicks" and other characteristic sounds made by these people as a part of their speech can be plainly heard. Such records are of enormous value, not only for the student of phonetics and philology, but also for the ethnologist and student of folk-lore.

The group of musical records also covers an extremely wide field. The chief feature of the musical department so far is the wonderfully rich collection of exotic records from other lands. Papuans can be heard playing on bamboo flutes, and Zulus singing their dancing war-songs, hunting-songs, and wild laments The plaintive sounds of the "cornemuse" of Brittany and of the Scottish bagpipes are not wanting.

One very strange series of records shows the peculiar way of chanting the Bible practised by certain Eastern Jews—a subject of study equally interesting to philologist, ethnologist, or musician The records, of course, are very often of many sided interest, as, for example, the Sanskrit collection, or the strange old "Regos" songs sung by Hungarian peasants on New Year's night, and *thought to date from heathen times*

The third main group of the Archives' records, that containing the voices of famous persons, is small as yet, but already has historic value Some of the speakers, notably *actors, can already be distinguished by their* speech as belonging to a past generation, although the oldest of the records does not go back more than twenty four years Thus quickly do the fashions of speech change! It is easy to see that such a gallery of "voice portraits" may be of enormous interest to both scientists and historians in the future

Miniature Locomotives and Railroads in Europe

By the courtesy of Mr Henry Greenly (Assoc Inst Loco Engineers, England) we present the accompanying photographs and the following data of an interesting development of miniature railways and locomotives in England and on the continent Mr. Greenly, the designer of these locomotives, who has devoted the greater part of 25 years to the development of 15-inch gage railways, writes us that he has designed miniature engines for this gage on railways operating at Eskdale, Rhyl, Margate, and that he is in close touch with Herr Roland Martens, who is carrying out similar work in Germany

Here, in America, we think of these little locomotives as being used for pleasure, *mainly for* exhibition purposes at amusement parks It will come as a surprise to many to learn that the larger part of these little fellows have been designed for, and are in use on, a commercial railroad seven miles in length which *traverses one of the most beautiful* valleys in the mountain district of Northern England. Starting at Ravenglass, a junction on the main broad-gage line, the 15-inch line, which has taken the place of the original 3-foot gage railroad built in 1875, is in service throughout the year, carrying passengers in the summer months, and bringing out rock and crushed stone through the winter months. This line between Ravenglass and Eskdale has proved eminently successful during the past ten years.

Mr. Greenly designed his first 15-inch gage locomotive in 1904, which was tested out on the Duke of Westminster's private railway at Eton Hall, where it carried trains of 60 passengers at 26.4 miles per hour. Six of these were built and are still running. They are of the American "Atlantic" type, with 18-inch coupled drivers and 3⅝-inch by 6-inch cylinders. Then followed a larger model with 4¼-inch by 6¾-inch cylinders and 20-inch wheels. One of these more powerful 15-inch engines was placed on the Eskdale line in 1915 It is still in service and has covered over 150,000 miles. This engine formed the basis for similar Pacific-type engines, of the type shown in our illustration with six-coupled drivers. The last carried a pressure of 180 pounds per square inch.

These later locomotives have wide fireboxes, *following* the American practice. Mr. Greenly states that in such small locomotives the proportion of the boiler, in relation to the cylinder capacity, should greatly exceed the figures generally accepted by makers of small-gage *industrial locomotives.*

The heavy passenger traffic is transferred from the main-line trains at Ravenglass Junction, and frequently over 500 passengers are unloaded at this station at once. The newer engines can deal with 260 passengers in a single train, and traverse grades of as much as 2½ percent The latest locomotives are one-third full size, which is the accepted standard for all future 15-inch gage locomotives. Many of the trains run the whole seven miles non-stop. This is indeed a test for endurance. It is only possible by the use of ample heating surface, duplicate injectors, water gages, and tenders, holding sufficient water for the round trip. The first "Mikado" engine to be built in England was the "River Esk," with eight coupled drivers. It has hauled 270 passengers on a 30-car train. Two engines of this type, built for Count Zborowski, have made 35 miles an hour with 10 cars. At 45 percent cut-off they have developed 40 horsepower. They have hauled 34 tons up a 1 in 60 grade. Their cylinders are 5¼ by 8½ inches; drivers 25½ inches diameter; boiler pressure 180 pounds per square inch; tractive effort 1470 pounds; total weight, locomotive and tender, 178,000 pounds; *total length 24 feet 9 inches*; width 37 inches; height 57 inches.

We show a view of a locomotive built by Herr Martens, from Mr Greenly's designs, for the Transport Exhibition at Munich. Three *were* built, *following* the design of the Zborowski locomotive.

A New Way to Illuminate Microscopes

When using the compound microscope it is necessary to throw relatively strong light on the object which is being viewed. Always this has been done by means of daylight or electric light, the rays being reflected on the object either from above it or from below it

Now that the process of making fused quartz glass in various sizes and shapes has become practicable, a new way to illuminate the object under the microscope has been found. A bent rod of the new quartz glass is placed under the object, as shown in the illustration

If one were to do this with ordinary glass, however, so little of the light that entered the end of the tube would find its way around the corner that the arrangement would be useless. It is, however, a peculiarity of fused quartz glass that light will follow through it, around a corner—a *phenomenon* which *is almost* uncanny when observed.

Light from the lamp follows up through the solid quartz rod, illuminating the object

The facts that quartz absorbs a very small portion of the light, and has a high melting point, make its use in this work advantageous. The light conveyed through a solid quartz rod is sufficiently brilliant to illuminate high-power objectives without the additional use of substage condensers. The rod also gives better detail than the ordinary *methods of illumination. The ends* of the rod are ground uniformly, but not polished. Diffused light thus obtained obviates all trouble from images of the filament. It is also possible to work farther from the light source *to avoid heating of specimens.*

(*Continued on page 188*)

130,000 times better

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Miss S. B. Leiter, metallographist, in the research laboratory of the General Electric Company, has been obtaining satisfactory results with several types of clear fused quartz illuminators. For use with the ordinary small microscope, a half-inch quartz rod with a right-angle bend is used The light source is a small moving picture lamp, with the lens removed The intensity of the light is regulated by a rheostat. There is less loss of intensity than when the light is reflected from a substage mirror, and the light can always be directed to the stage of the microscope where wanted

In the case of the inverted type of microscope, where illuminating a transparent specimen has presented difficulties, the use of quartz rods is especially convenient. Since intense heat does not shatter quartz, one end of the quartz rod can be placed immediately over an arc, and better illumination conveyed to the specimen

* * *

The Einstein Theory at the Recent Meeting of the American Association for the Advancement of Science

EASILY the outstanding feature of the recent annual meeting of the *American Association for the Advancement of Science*, as the writer saw it at Kansas City, was Professor Dayton C Miller's announcement that he had carried his previous experiments on ether drift to the extent of making over 100,000 observations, largely during the past summer, and that they apparently prove the existence of an ether drift

The significance of this result, if it is substantiated, is that the Einstein theory must be very seriously affected In fact, Professor Einstein, himself, makes the flat statement that, "if Dr Miller's results should be confirmed, then the special relativity theory, with the general theory in its present form falls" Continuing, Professor Einstein says, "Experiment is the supreme judge"

What finer example of the true, sportsmanlike spirit of the scientist who searches only for the facts rather than for a vindication of his own life work could possibly be adduced than this clear, unequivocal statement

Professor Einstein, it will be remembered, threw out the ether of space very largely because of the negative results reached in 1887 by Professors Michelson and Morley, in which they found no ether drift. All the phenomena of nature go on, said Einstein, precisely as though there were no ether

More recently it occurred to Professor Miller that the now famous Michelson Morley experiment was performed in a basement, and that had there actually been an ether drift, that is, had the earth in its motion been partially dragging the ether along with it just as a ship drags along the water near its hull, it was possible that the negative results of the original experiment was because the ether was so penned in by the cellar that any existing ether drift would not have been perceptible there.

So he began a series of experiments in the open air.

Last spring he announced at the meeting of the *National Academy of Sciences* that he had actually detected and measured an ether drift, working mostly on Mt. Wilson, California, and that it amounted to about one-third of the orbital velocity of the earth.

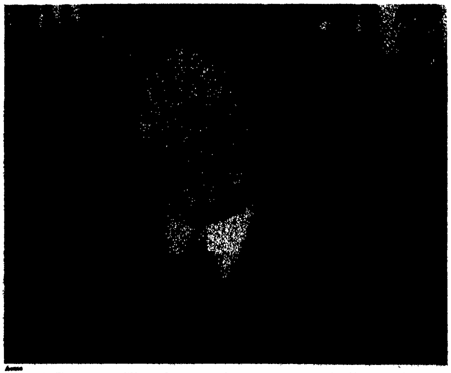
Professor Miller's results were not, however, received by science without considerable reservation Some scientists were inclined to pass them off rather lightly, as due, perhaps, to some systematic error in observation So all through the past summer Professor Miller has been busy repeating his experiment under still more favorable conditions.

After making more than 100,000 observations he has now finally announced his conviction that there is absolutely a positive, systematic drift effect, which varies throughout the day as the revolution of the earth on its axis adds to or substracts from the general effect. This effect also varies according to the direction of motion of the earth in its orbit Professor Miller finally concluded this year that all his observations were consistent with the assumption that the solar system is moving in space toward the constellation of Draco, with a velocity of more than 125 miles per second, and that as it moves, *the ether drags about 95 percent and slips about 5 percent.* This may depend, however, on local contours of the earth's surface.

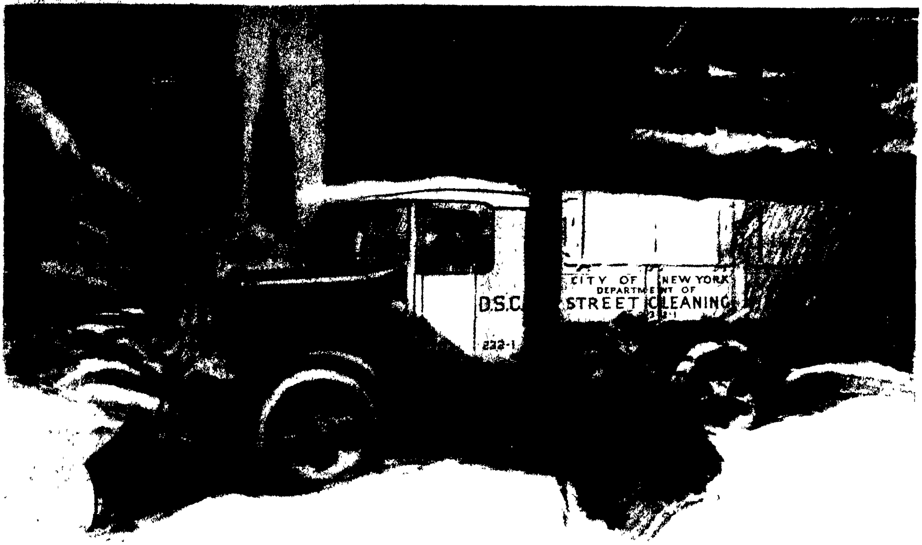
In the August issue of the Scientific American we saw, on the other hand, how two other recent experiments strongly favored the Einstein theory, one being the Michelson Gale pipe experiment, conducted last winter near Chicago, the other the spectral shift of light coming from a star known as the *Companion of Sirius*, a star having a density some 5,000 times that of water.

Thus we are now presented with a sort of dead-lock between relativity and the old conceptions When scientists disagree, what is the layman to do? He must fold his hands and wait, perhaps for decades. Either that, or he can choose one or the other side and "root" for it, according to his temperament, and if one were to judge by many letters written to the Scientific American by bloodthirsty proponents of relativity, and by an equal number received from equally bloodthirsty opponents of this theory, it

(*Continued on page 190*)



Prof. Dayton C. Miller, whose experiments may upset the Einstein theory



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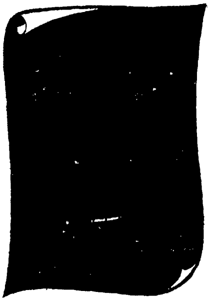

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would seem as if it were temperament, rather than that calm, "wait-and-see" quality of the true scientist, that is the governing factor in the formulation of many people's opinions about relativity.

The Scientific American, however, has no set opinion about the Einstein theory, one way or the other, preferring to wait until more actual empirical work has been performed on it. This, also, is the position taken by the majority of the world's scientists.

Those who wish to read technical but brief accounts of Dr. Miller's work, up to last spring, will find it described in the *Proceedings of the National Academy of Sciences, Vol. 11*, pages 306-314; the Michelson-Gale pipe experiment was described by the actual experimenters in the April, 1925, issue of the *Astrophysical Journal*, pages 137-145.

It must be remembered that the pipe experiment does not, as some have said, prove simply that there is no ether, but, in the words of Prof. J. H. Jeans, it shows that "there is no ether or else that *if there is an ether*, the earth does not drag this ether into motion by its rotation." In the latter case, there would be a flat contradiction between the work of Miller and that of Michelson and Gale.

At the recent meeting of the *American Association for the Advancement of Science*, Professor Charles E. St. John presented a paper on the astronomical evidence for gravitational displacement of spectrum lines, favoring relativity. Professor St. John is a solar physicist, and is a member of the staff of the Mt. Wilson Observatory, California. He is one of the leaders in the group that favors the Einstein theory, partly by reason of the work done by himself and by Dr W. S. Adams, in which they detected the Einstein shift, due to the gravitation of the sun and stars

Dr Miller, however, displayed at Kansas City a lantern slide showing the data from which a certain curve purporting to establish the Einstein shift in the lines of the solar spectrum was drawn, and he left it to his audience to decide whether the basis of this curve, a large mass of somewhat scattered dots, was sufficiently determinative to warrant the issue of positive statements favoring the Einstein theory as were issued several months ago From the dots obtained by the Einsteinists a curve could be drawn, without a doubt, but its definiteness did not give one an overpowering sense of proof

A great many people after reading yearly the numerous interesting press reports that emanate from great gatherings of scientists, such as the one referred to above, inquire what they are actually like, what the scientists do at the meetings, what sort of people they are when taken *en masse*. This, of course, is the sort of thing that does not get into the newspapers, it is too informal.

The annual meetings are held during the Christmas holidays and in selected cities. The great majority of those who attend are college professors. This year, Kansas City was chosen because it was rather farther west than usual, and this fact was reflected in the personnel of those who attended; they came very largely from the middle west and far west.

What do these men do after they get there? It would be manifestly impracticable for them to meet always in a single body, although like Congress they do meet thus once daily on the average. Like Congress, also, most of the work is done in small and more wieldy groups. For example, the mathematicians meet together; so do the physicists, the chemists, the astronomers, the geologists, the zoologists, and so on. Papers are read before groups of from 25 to 200 listeners. Usually these papers are illustrated by lantern slides. Discussions follow these papers and thus the sessions go on all day long

At night there is usually a general lecture of some sort which would interest most of the scientists as well as the more intelligent local people. It may interest our readers to know that anyone is welcome to attend the sessions of the American Association for the Advancement of Science. Next year's meeting will be held in Philadelphia, after Christmas.

To the outsider, the scientists are ostensibly meeting only for the interchange of ideas through the formal reading of papers and through their public discussion Actually, however, these men do not travel long distances for this purpose alone, for in a great measure this work could be covered and is actually covered by the many publications in the field of science Therefore, it would probably be found, if any quantitative measurement were possible, that most of those who attend, do so in order to see other scientists, both in their own and in other lines of work, and to talk with them between lectures, in the hotel lobby or their rooms They talk shop, renew old acquaintances and form new ones And at these meetings all sorts of general scientific policies are formulated Irritations between workers disappear when they meet thus, face to face Everyone gets to know everyone else, not merely from his writings but by face, voice and temperament.

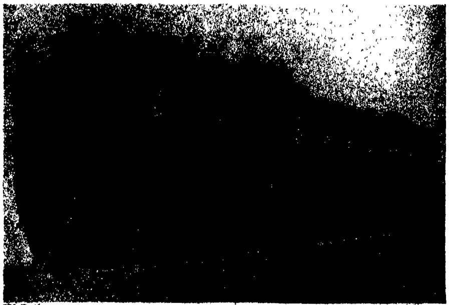
Thus, it is largely the *human* aspect of these meetings that bring men hundreds of miles to attend them.

* * *

A New Oil-Electric Railroad Car

In making a broad survey of the field of transportation, one is increasingly impressed with the rapidity and the wide extent to which the internal-combustion engine is winning its way. So true is this, that one begins to ask whether, both by sea and land, the age of steam is not about to give way to the age of oil, as represented by the internal combustion motor

(*Continued on page 192*)



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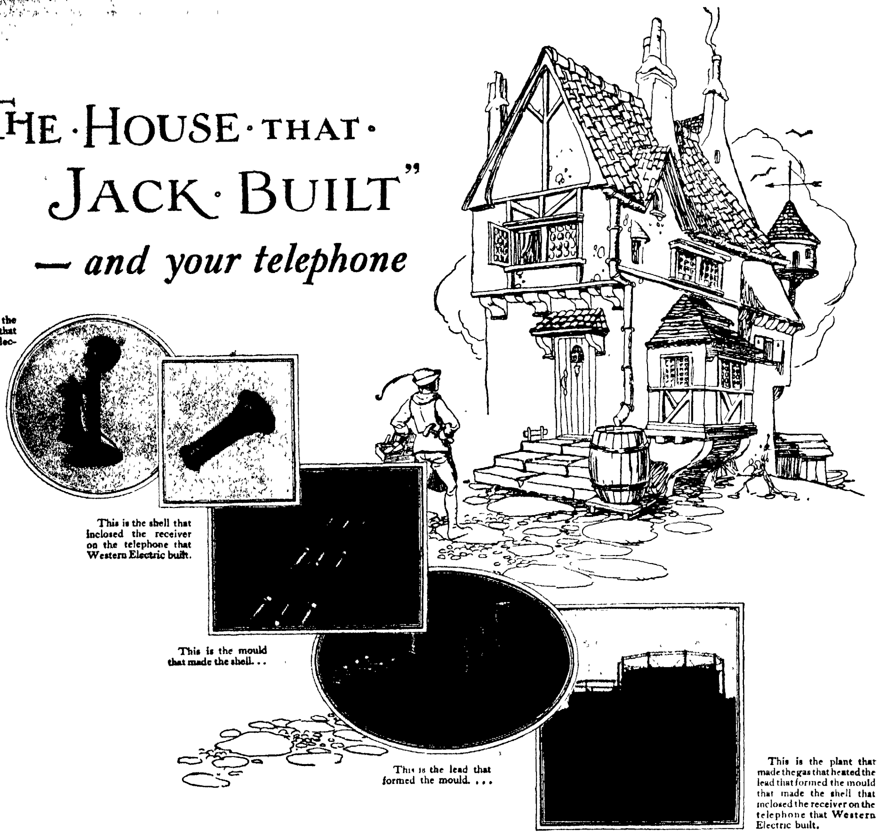

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In offering the above thought we are not unmindful of the great part which has been, and is indeed today, played by the electric motor, which is so extensively in use as to suggest that future historians writing on transportation will speak, distinctively of the electrical age

We are inclined to think that the era upon which we have entered, so far from superseding the use of electric power, will enhance it, for in transportation, at least, the oil engine and the electric motor promise to become inseparable The even torque and the marvelous flexibility of the electric motor render it an ideal reduction gear between the high-speed oil engine and the lower and ever varying speeds required on the driving wheel of the car or the propeller of a ship, be it yacht, merchant ship or naval vessel

No apology need be offered on behalf of the *steam locomotive* which has been the supreme agent in developing the world's far flung railroad systems For main line, express, and freight traffic it stands today at the close of its first century of operation without a rival, except for heavy trains on hilly sections of a road Its weak point, hitherto, has been found on the score of economy, for the locomotive has acquired the reputation of being an extravagant consumer of fuel But the very fine work which has been done in the improvement of the economy of the locomotive during the past few years has brought it up particularly in the latest types, to a very respectable standing among other prime movers in respect of its economy and high pressure steam, superseding the recent introduction of the water tube boiler, as seen in the "Horatio Allen," to say nothing of the improvements in valve gear, are full of high promise of economy in the future

On the other hand, locomotive builders and users have realized for many years past, that for local and branch service, where traffic is not heavy, the steam locomotive is an extravagant form of motive power, and it is in this particular field that the internal combustion engine, when combined with the electric motor has proved its great value

We illustrate an oil-electric car which has been recently placed in service on certain lines of the Canadian National Railways. Two types of these cars have been developed; one a 60-foot car carried on four-wheel trucks, and the other a larger type, which is known as the articulated car, and consists of two bodies with an overall length of 102 feet, which is carried on three four wheel trucks Both of these types are designed for carrying passengers, express and baggage The single passenger car accommodates 57 passengers, 18 of whom are provided with side seats in the baggage compartment The two-body articulated car can seat 126 passengers, all of whom find room in the passenger compartments. The cars are being built at the Poynte St Charles Shops, Montreal, of the Canadian National Railways.

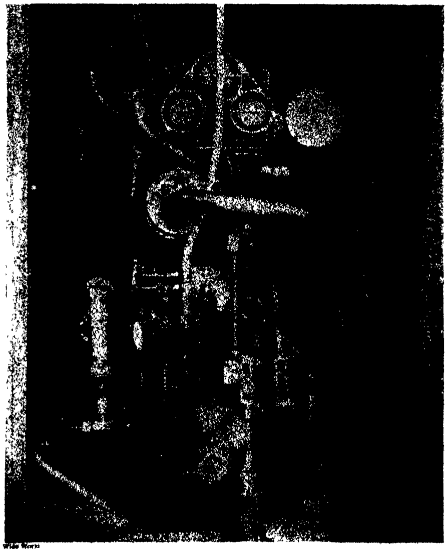
The *power plant of each car* is in the forward end of the baggage compartment, and it consists of an oil engine directly connected to a direct current generator, the cars being driven by standard railway type motors mounted as usual on the trucks For the 60-foot car the plant consists of a modified Diesel cycle of the solid injection four stroke cycle type, there being four cylinders in line, for the articulated car the engine consists of eight cylinders in line

For fuel a light residue oil of 0 86 specific gravity is used, the lubricating oil is forced under pressure to all working bearings, the oil is filtered, and before entering the tanks it circulates through a cooler on the roof

The engine is started by the generator driven as a motor from a 300-volt battery, and the battery also supplies the control circuits at 30 volts, the generator field excitation at 300 volts, the two air compressors at 300 volts, and the air cooling system at 30 volts

The car bodies are built of steel throughout. The inside finish is of mahogany. The articulated system originated in England, and fast express trains consisting entirely of articulated cars have been operated successfully for several years on trains running

(*Continued on page 194*)



Wide World

The Diesel engine which drove the oil-electric car shown on page 190. During the entire run of 5,874 miles this engine never stopped running

Was this a hint?

THIS was the third time it had happened within a month he, the head of the concern, finding one of these advertisements on his desk marked for his attention, no signature.

Of course, he had read about Listerine and halitosis. But never had he applied the idea to himself.

Was someone giving him a hint? Was he, perhaps guilty this way, and successful in spite of it? It certainly set him thinking.

* * *

You, yourself, rarely know when you have halitosis (unpleasant breath). That's the insidious thing about it. And even your closest friends won't tell you.

Sometimes, of course, halitosis comes from some deep-seated organic disorder that requires professional advice. But usually—and fortunately—halitosis is only a local condition that yields to the regular use of Listerine as a mouth wash and gargle. **It puts you on the safe and polite side. Moreover, in using Listerine to combat halitosis, you are quite sure to avoid sore throat and those more serious illnesses that start with throat infections.**

Listerine halts food fermentation in the mouth and leaves the breath sweet, fresh and clean. *Not* by substituting some other odor but by really removing the old one. The Listerine odor itself quickly disappears.

This safe and long-trusted antiseptic has dozens of different uses, note the little circular that comes with every bottle. Your druggist sells Listerine in the original brown package only—*never in bulk*. There are four sizes 14 ounce, 7 ounce, 3 ounce and 1¼ ounce. Buy the large size for economy. —*Lambert Pharmacal Company, Saint Louis, U. S. A.*

For HALITOSIS use LISTERINE

A CHALLENGE

We'll make a little wager with you that if you try one tube of Listerine Tooth Paste, you'll come back for more.

LARGE TUBE—25 CENTS

On Municipal Docks

Yellow Strand Wire Rope lends a helping hand in the transfer of shipments between dock and river barges.

Big loads are handled as safely as little ones and economy is certain.

Made by one of the oldest wire rope manufacturers, virtually pioneers in the industry, Yellow Strand has a thoroughly established reputation for strength and long life.

The strand of *yellow* is the quality mark of Yellow Strand—and your protection.

This company also makes all standard grades of wire rope for all purposes.

Motorists

Carry a Basline Autowline in your car and safeguard your spare tire with Powersteel Autowlock. Both are made of Yellow Strand. Ask your accessory dealer.

BRODERICK & BASCOM ROPE CO.
843 North First Street, St. Louis, Mo.
Eastern Office and Warehouse: 76 Warren St., New York City
Western Office: Seattle *Factories.* St. Louis and Seattle
Authorized Dealers in all Industrial Localities

Yellow Strand
WIRE ROPE

JR484

WHY NOT spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth $1 to $7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10 cents (not stamps) for my Illustrated Prospectus before sending butterflies. MR. SINCLAIR, DEALER IN INSECTS, Dept. 36, Box 1424, San Diego, Cal.

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AND POWER LAWNMOWER
A Practical, Proven Power Cultivator for Gardeners, Suburbanites, Truckers, Florists, Nurserymen, Fruit Growers
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MALLEABLE CASTINGS
Rough or Machined

We specialize on machined malleables in quantity production. Many users who operate large machine shops in connection with their business find it to their advantage to buy of us. Perhaps you could do likewise.

BENTON HARBOR MALLEABLE FOUNDRY CO.
Benton Harbor Michigan

Huther Brothers
Small Saws and Groovers
3 to 6 inch sizes

Specialties for small cutting and grooving. Write for information and prices.

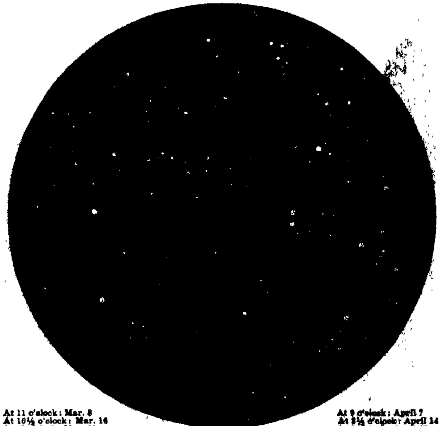
Huther Bros. Saw Mfg. Co.
ROCHESTER, N.Y.
Makers of Better Saws for More Than Fifty Years

from London to the north. On the articulated car under discussion the center truck supports one end of both the front and the rear car bodies. At the junction each body carries a cast-steel end sill, to which are bolted male and female center castings, one resting within the other and both engaging the truck center plate.

Both the single and articulated cars have maintained a speed on level track of about 60 miles an hour, and the fuel consumption for non-stop runs worked out as 3.5 miles to the imperial gallon on the large car, and 7 miles to the gallon on the small car. In a test of the single car a run was made from Montreal to Toronto, [illegible] miles, in [illegible] hours and 30 minutes, the engine running continuously throughout the trip. The cost of the fuel oil used on this trip was about $3.50, and of the lubricating oil [illegible] cents. Another remarkable run was made from Montreal to Vancouver, a distance of 2,937 miles, in 72 hours total and 67 hours actual running time, at an average speed of 43.8 miles per hour. The oil-engine, it should be noted, ran continuously for the whole 72 hours. The car consumed .206 imperial gallons per mile, at .266 cents per mile.

The Heavens in March

By Professor Henry Norris Russell, Ph. D.



At 11 o'clock: Mar. 8
At 10½ o'clock: Mar. 16
At 10 o'clock: Mar. 23
At 9½ o'clock: Mar. 29
At 9 o'clock: April 7
At 8½ o'clock: April 14
At 8 o'clock: April 22

NIGHT SKY: MARCH AND APRIL

The Heavens

ALL four of the prominent clusters which are mentioned in the article on p 157 are now in full view, and all may be found upon our map. At the stated hour, the Pleiades are low in the west, northwest and the Hyades not far away—at an equal altitude, and a little to the left—marked by the bright star Aldebaran. The Praesepe cluster is high in the southwest, about midway between Gemini and Leo, while Coma Berenices is well up in the east above Arcturus. To the naked eye, Praesepe is but a hazy blue, but the individual stars of the other three groups are easily seen.

The winter constellations are still in sight, but we shall soon lose them. Taurus, Orion and Canis Major are all low in the west and southwest. Auriga, Gemini and Canis Minor are above them. Leo is high in the south with Hydra below, and Virgo, Crater and Corvus are in the southeast. Boötes, Corona and Hercules are in the east and northeast. Ursa Major, high in the north with Draco and Ursa Minor below and Cassiopeia and Cepheus on the horizon.

The Planets

Mercury is an evening star this month and can be best seen on or about the 14th, when he is farthest from the sun. Being close to perihelion, his elongation is small, only 18 degrees, but this is compensated for by unusual brightness and by a favorable position north of the sun. He remains above the horizon till 7:30 P.M.

Venus is now a morning star and at her greatest brilliancy. She rises about 4:40 A.M. on the first and 3:50 on the 31st and is the chief ornament of the morning sky.

Mars is a morning star, too—rising at 3:30 A.M. in the middle of the month, but is still more than 150,000,000 miles away and looks only about as bright as Antares. Jupiter is a morning star like the others and rises at 4:45 on the 15th. He is in conjunction with Venus on the 22nd, but, even at their nearest, the planets are almost five degrees apart.

Saturn is in Libra and comes to the meridian about 4 A.M. Uranus is in conjunction with the sun on the 17th and is invisible. Neptune is not long past opposition and is well observable telescopically.

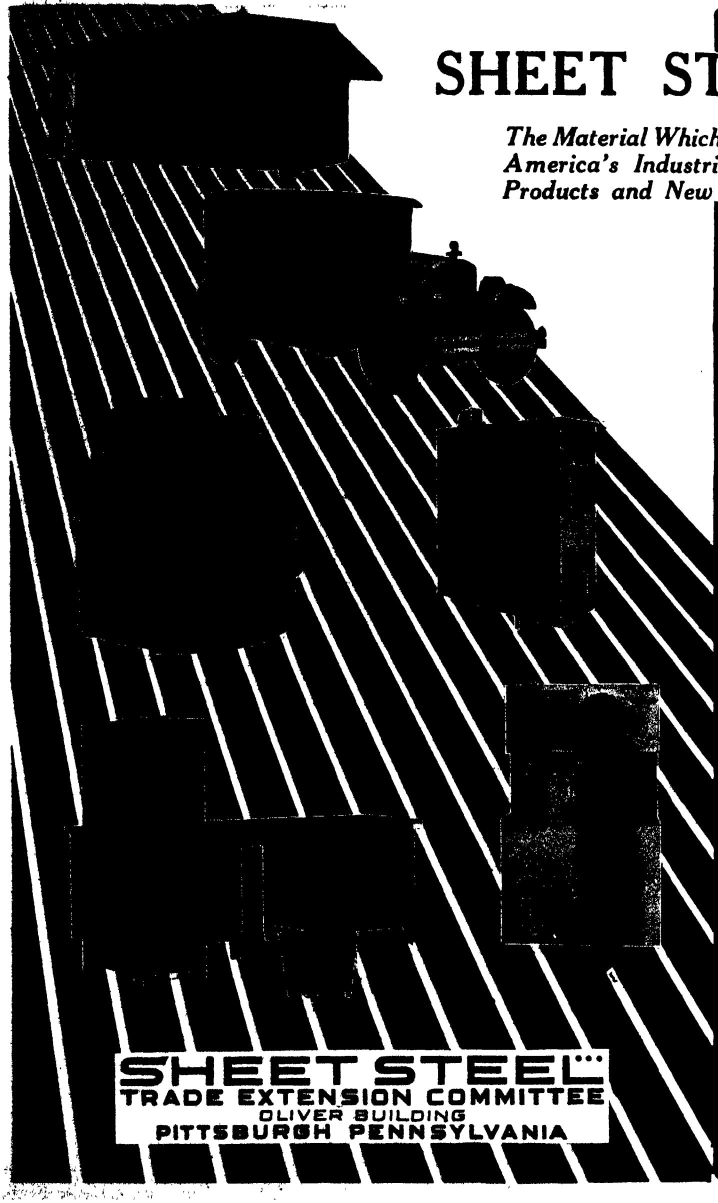
The moon is in her last quarter at 7 A.M. on the 7th, new at 10 P.M. on the 13th, in her first quarter just after midnight on the 21st and full at 5 A.M. on the 29th. She is nearest the earth on the 12th and farthest away on the 25th.

During the month, she is in conjunction with Saturn on the 5th, Mars on the 9th, Venus and Jupiter on the 11th, Uranus on the 14th, Mercury on the 15th, and Neptune on the 25th.

At 4 A.M. on the 21st the sun crosses the celestial equator and passes over the vernal equinox; wherefore, in almanac language, "Spring commences."

SHEET STEEL

The Material Which is Giving America's Industries Better Products and New Markets.



SHEET STEEL
TRADE EXTENSION COMMITTEE
OLIVER BUILDING
PITTSBURGH PENNSYLVANIA

Everywhere manufacturers are facing these problems—How can a better product be built that is practical? How can new markets be obtained?

Many of them will find the answer to both questions in Sheet Steel. Ford is said to have found that each time the price was lowered fifty dollars it added 1,500,000 more potential customers in this country alone. Sheet Steel enabled him time and again to extend his markets through greater economy. The recent announcement of All-Steel cars in both open and closed models, has been the natural result.

Sheet Steel office files have virtually done away with other types. Their compact construction, greater strength, rugged durability and fire-safeness have made them the universal choice. And now Sheet Steel is being adopted for other office furniture as well, from desks to waste paper baskets, from partitions to employes' clothes lockers.

Hotels, hospitals and residences, too, are turning to Sheet Steel for their furniture requirements. It offers increased sanitation, it is easily cleaned and its beauty endures the most severe tests of use and abuse. Today Sheet Steel finishes in either wood grains or flat enamels can be had which resist smoke, water and dirt. A bottle of perfume may be spilled on a steel dresser top without damage. A cigarette can burn itself out on the polished surface without a trace.

Manufacturers and designers will do well to study the many applications that are being made in Sheet Steel. Many of these have brought about new production methods that offer possibilities undreamed of a decade ago. Through proper standardization and organized large-scale operations they permit offering the buyer better products and better values.

A magazine called "MAKING MARKETS" is published by the Committee for the benefit of manufacturers and designers. If you are not now receiving copies they will be mailed you regularly on request.

From One Sentence To Millions

On March 10, 1876, a single sentence was heard over the telephone. Now, after half a century, 50,000,000 conversations are heard each day.

"Mr. Watson, come here; I want you," spoken by Alexander Graham Bell, the inventor, was the first sentence.

His first crude instruments had been tested by sounds and single words; the patent had been granted; the principle was established from which a world of telephones has since resulted. But at that time the telephone had not proved its practical usefulness—its power to command.

Bell's words, electrically transmitted over a wire, brought his assistant from another part of the building. And with his coming, the telephone became a dynamic factor in human affairs.

Since that first call untold millions of sentences have been heard over the telephone. Men have traveled vast distances in answer to its calls. The wheels of great industrial enterprises have turned at its commands. Everything that man can say to man has been carried to a distance over its wires and the thoughts and actions of nations have been influenced through its use.

American Telephone and Telegraph Company
and Associated Companies

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

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"SOLUBLE" TREATMENTS PETRIFY

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UNISOL produces desired results throughout the world—WHY? Because it is not detrimental IT IS SOLUBLE

Fifteen years of observation and application prove it, BOILERS PROVE IT

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Easy Payments Pay only a few dollars down and take a year for balance of low price. Make your own terms. One-profit—sold direct from factory to you.

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DOMESTIC APPLIANCE PUBLISHING CO.
475 Eighth Avenue - New York City

Science and Money

The Oil Industry

By Henry C. Trundle

THE high mark in crude oil production in the United States was reached in 1925 when 758,500,000 barrels were obtained Twenty years ago this country's consumption amounted to only about 100,000,000 barrels Thus has the tremendous growth in the number of automobiles and the general use of oil for power, heat and light made this product of front-page importance Discoveries of new fields and improved production knowledge have taken from oil some of its romance, and have made it a respectable industrial commodity.

Despite heavy production in each of the past few years, with the largest increases in 1923 and 1924, the year 1925 closed with the industry in a better condition than it has occupied since 1920 Consumption demand, like the demand for autos, had run much ahead of forecasts, so that there was a smaller carry-over to stocks. Prices of crude oil were practically stabilized. When it came time to prepare reviews for the year, commentators confined themselves mostly to laudatory remarks on the excellent current position of the industry and to conjectures concerning prospective company mergers within it.

Science and Oil Production

At one time oil production was carried on very haphazardly, but such ways have been discarded in favor of the scientific methods of the geologist and the petroleum engineer, who are sponsored by financially able concerns Stories regarding the work of these prospectors in domestic and foreign fields are featured items in newspapers and magazines. For the most part the industry is now in the hands of huge corporations, whose affairs are subject to the closest scrutiny Rumors of malpractices have been rampant, so that the word "oil" is often associated with political scandal. In recent years our government has been disturbed by the disclosures brought to the public's attention through various investigations, and for a time some sort of an international fracas seemed imminent It is therefore encouraging to read that the industry is now on a sound basis

Since oil is of such major importance and its continued supply a matter of conjecture, a great deal of study has been made to determine its source, the nature of its constituents and the probabilities for a larger production to meet a growing market. Several theories have been advanced as to the origin of oil, all based logically on apparently sound propositions. For some time it was thought that petroleum was formed by inorganic agencies, which depended upon volcanic phenomena. Chemists, through laboratory tests, proved to their satisfaction that this was the case.

Oil Where Life Was Abundant

The belief was that the core of the earth was composed largely of the carbides of the common metals (especially iron), and that chemical reaction took place as water penetrated to that depth. The resultant gases were thought to seep through cracks to the surface and to cool there as a liquid. This theory, at first hard to disprove, has now been replaced by the organic theory which forms the basis for most new geologic investigations. Those who hold to this theory believe that oil is converted from materials which have been deposited in certain areas at the time of geological changes.

Oil is expected to be found only where life is known to have been abundant. The color of rocks, their chemical nature and the manner of their formation are therefore important items. So difficult is it to analyze the mother substance of oil that the organic theory has been grouped under two heads—the animal theory and the vegetable theory. That oil is found almost entirely where animal and plant life has been dense gives credence to these viewpoints.

The oil industry has come to be regarded as separable into the following divisions: (1) production; (2) transportation; (3) refining; (4) marketing

Some companies confine their operations to one phase of the business, while the present tendency toward stabilization in production and price has led to other companies undertaking all four functions as a part of their organization. The current activity in regard to consolidations is in line with this policy and will have a positive effect in the establishment of the industry upon recognized economic principles.

Geological Data Necessary

Before wells can be worked, oil must be found. If the geological structure of the entire world were known and recorded there would be little need for extensive scientific expeditions to distant lands. For the most part domestic fields are known, and are owned or leased by the major companies, which fact precludes in a measure the possibility of some group gaining quick wealth through a new discovery. It is the usual practice to lease, or to obtain the right to drill upon any lands where the presence of oil is suspected. It is less expensive to carry a lease for large areas for years than it would be to purchase the same lands after oil is found there. Sometimes land is purchased outright from the individual or government, or it is exploited under an equitable arrangement Frequently the larger companies have access to a wide area through the ownership or lease of plots arranged in checkerboard fashion, the land thus being held in alternate squares. This is more satisfactory than holding a solid block, since a much larger area can be advantageously controlled with the same capital outlay.

Methods of Drilling and Transporting

In the United States the most productive field has been California, where, in 1925, 231,673,000 barrels were produced, or over one-third the country's entire output. Texas, Oklahoma, Wyoming, Kansas, West Virginia, Louisiana, Pennsylvania, Ohio and Kentucky are the other chief producing states. Mexico, perhaps more than any other country, is known to us for its oil Venezuela, Peru and Colombia, in South America, are likewise important In the Old World, fields are found in Russia, Rumania, Egypt, Persia, Mesopotamia, India and Japan.

Actual drilling operations are considered either as wildcat operations or as production drilling. Wildcat operations are entered upon because of "hunches," or are so regarded because of the lack of proper geological knowledge. Production drilling is the work of sinking wells in predetermined areas. The old-time method of hand drilling has been supplanted by machine drills and various systems have been developed to utilize these to the best advantage.

While the work of locating and producing crude oil is highly colored with romance, the other stages in making the finished product available to the consumer are not without their own colorful aspects. At first it was necessary to transport oil in small barrels or in bottles When the Pennsylvania pools were opened up it was estimated that there were in operation more than 6,000 carts, each drawn by a team of horses. Next came cumbersome railroad box-car shipments and short pipe lines. Today we are familiar with railroad tank cars of steel construction, and with a capacity of over 100 barrels each. Our harbors are visited frequently with huge tank ships, the larger tankers, plying between the Pacific and the Atlantic coasts.

In many ways the pipe line appears as the logical method for transporting oil from the

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field to the large markets or to storage places. Except for short lines, between pools or to shipping points, the pipe-line system, however, has not been generally adopted except in the United States. Here a trunk-line system has been developed connecting the productive areas in Texas with the consumer in New York, as well as points intermediary Perhaps the largest line other than this is the line between Baku and Batoum, on the Black Sea, which was 600 miles long, and now believed to have been destroyed by recent revolutions

Storage a Problem

The problem of storage naturally arises with the consideration of transportation At the present time it is the practice to store oil in tanks which average between 40,000 and 80,000 barrels in capacity In the largest producing areas will be found concrete-lined reservoirs to hold 100,000 to 5,000,000 barrels Because of the danger from fires, it is advisable to utilize the smaller tanks, thus a cluster of these is located usually not far from retail districts

So far we have been concerned with oil only in the crude state, which is of little value to the average consumer The extraction from crude oil of its various products—benzine, naphthene, kerosene, gasoline and dozens of others—is the work of refineries and while these products are obtained simultaneously, they require distinct operations One needs to be well up on one's chemistry to understand how but slightly different conditions result in the various familiar oils The first procedure is to physically separate the several fractions contained in crude oils This is done usually through distillation and condensation, although the processes of cold pressing, cold settling, centrifuging and sweating are used

Study the Offerings Made

Refining plants are designed to treat the particular crude oils that come to them so that the proper products will be obtained Gasoline, naphtha and kerosene need to be in a highly purified state, while the solid fuels need not be purified The stills, usually five or six in number are so arranged that the oil flows by gravity from one to another the desired fractions being removed at the proper instant

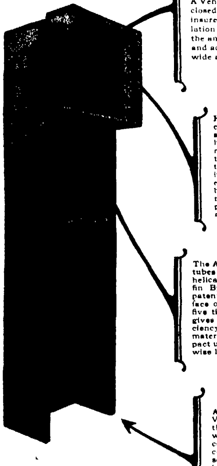
The astounding growth in demand for gasoline, together with the rapid rise in price has been the impetus for much experimental work directed toward an increased production. The result has been many new processes, the most important of which is cracking, or the breaking up of heavier oils through pressure under certain time, temperature and catalytic conditions Full use of this procedure is now hampered by various patent suits

The ultimate aim of the oil man is to place the finished product in the consumer's hands This phase of the business is not complicated by chemical formulas such as are encountered in studying refinery operations, and is perhaps the branch most familiar to the public Competition has made it necessary that the selling and distributing organizations be efficient to the extreme. Most refineries sell their output direct to retailers, and their problem is not so much one of sales as one of delivery Refineries are located naturally near their markets or close to adequate shipping facilities

Is there anyone who at some time has not dreamed of sudden wealth through oil? Because of the known instances of great wealth that has come out of the industry to a very few, and because the dramatic elements are present, oil stocks have carried an enormous appeal. Probably more money has been lost by the public in oil stocks than has been actually made by the operators.

Oil, clearly, is an essential commodity, and the business of production and sale a legitimate one. The industry does not deserve the speculative stigma clinging to it. Investors will therefore improve the investment side of the oil business if they will really study the offerings made them, rather than pour out their money indiscriminately.

... a heating method that actually Forces HEAT all over your BUILDING



A Ventura fan driven by a fully enclosed industrial type electric motor insures a definite positive air circulation through the heater—enables the amount of heat to be regulated and actually forces the heat over a wide area in the direction desired

Heat is forced over the highly efficient Aerofin heating coils (described below) into the areas to be heated and not in one corner of the room or against the wall This feature in itself is worth the price of the Venturafin Method of Heating—it reduces heat loss to a minimum, enables the Venturafin Method to heat up more quickly at any time—makes it possible to keep even temperatures over large areas—and aids ventilation

The Aerofin heating coil is made of tubes of copper and brass, each tube helically wound with a continuous fin By this construction which is patented the heat transmitting surface of the tubes are made nearly five times greater which not only gives you greater heating efficiency but also reduces fuel costs materially and enables a light compact unit to do the work of an otherwise large and bulky unit

A recirculating box completes the Venturafin unit—it takes the air off the floor and feeds it to the fan whence it is forced over the heating coils and back into circulation The complete unit represents the most scientific method of industrial heating It is based on sound, proven principles and can be used with either steam or hot water

The Venturafin Method of Heating

And this sound, proven method of heating can be purchased cheaper than ordinary heating equipment and the installation and maintenance costs are lower.

Write for complete details or ask your heating contractor to tell you of the benefits of the Venturafin Method of Heating.

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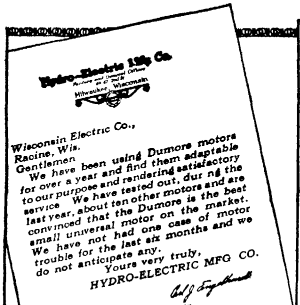

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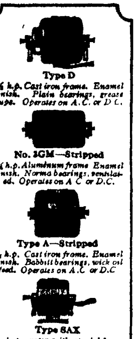
Yours very truly,
HYDRO-ELECTRIC MFG CO.
Carl J. Engelhardt

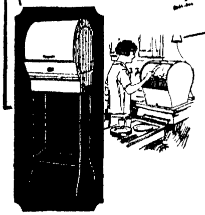


Type D
½ h.p. Cast iron frame. Enamel finish. Plain bearings, grease cups. Operates on A.C. or D.C.

No. 3GM—Stripped
⅛ h.p. Aluminum frame Enamel finish. Norma bearings, ventilated. Operates on A.C. or D.C.

Type A—Stripped
1/20 h.p. Cast iron frame. Enamel finish. Babbitt bearings, wick oil feed. Operates on A.C. or D.C.

Type SAX
1/20 h.p. motor with special base Nickel plated. Operates on A.C. or D.C.



The Hydro-Electric Dishwasher has removed the drudgery of dishwashing from thousands of homes. It's DUMORE equipped, of course.

DUMORE
Fractional H.P. Motors

are giving trouble-proof service in thousands of places where a small motor must absolutely be depended on. Our Engineering Department knows how to adapt small motors to hard jobs. If you are developing or improving a motor driven device, perhaps we can offer some suggestions that will help you. No obligation at all—just write or wire.

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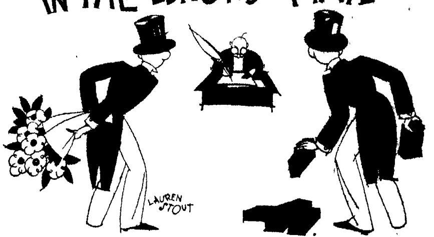
IN THE EDITOR'S MAIL



Nature in a Playful Mood

The cyclone at Murphysboro, Illinois, recently produced many freakish results, one of which is shown in the accompanying photograph enclosed with a note from our correspondent:

> "This tree stood in the Logan school yard at Murphysboro, Illinois.
>
> "The 1 by 10 board was driven into the tree by the cyclone that devastated Murphysboro, Illinois, March 18, 1925, about 3 P. M.
>
> "The board hit the tree about seven feet from the ground and is so firmly driven into the tree by the velocity and force of the wind that it bore the weight of a 150-pound man hanging on it without loosening it in the least.
>
> "In the top of the tree is a carpenter's horse also blown into the tree by the force of the wind."

Dr. Prince Comments Further on Spirit Photographs

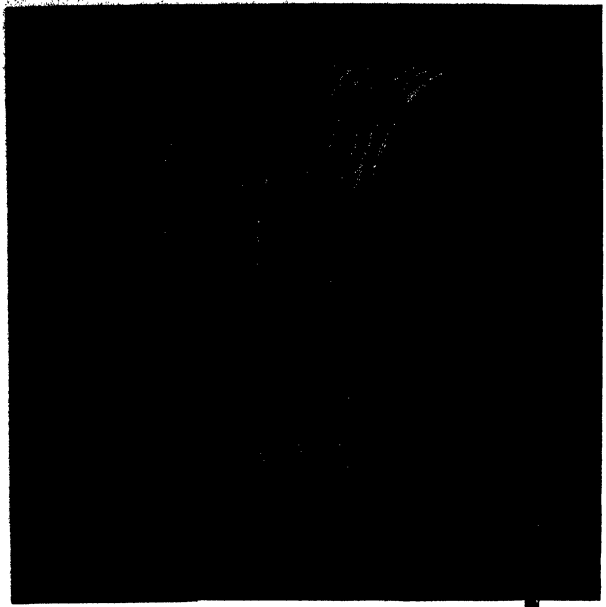
Some days before our February issue, in which we published a letter from Sir Arthur Conan Doyle, appeared on the newsstands, we received an item from Dr Walter Franklin Prince, author of the article on spirit photographs in our December issue. He has called the item "A Footnote"—and it is a reply to Sir Arthur's comments on his article which had come to him from various sources.

Since my article entitled "My Doubts About Spirit Photographs" appeared in the December Scientific American, I have received and am still receiving many press clippings from this country and the British Islands, professing to quote from Sir Arthur Conan Doyle to the effect that I am "hopelessly prejudiced," "always doing this kind of thing," "have quoted him wrongly," "was not the first one to expose the Murillo fake," et cetera.

It happens that I am so superlatively cautious in my allegations as to facts and in my phraseology that, so far as I can recollect, no statement of mine in relation to psychic research has ever been convicted of error, so long as attention has been limited to what I actually said. But I have a number of times been branded as "prejudiced," "unfair," having "much to learn," and the like, by means of a process of diverting attention to irrelevant details and intimating that they were an integral part of my original statement. It may be interesting to readers to see how the reporter of exact facts was made to appear a sinner, first in relation to the Murillo forgery, and secondly as to the fake photograph of the "spirits" of Chicago firemen exhibited by Sir Arthur upon the screen in New York.

(*Continued on page 200*)

What a cyclone can do. Note the saw horse also blown into the tree by the wind



In the Timken Steel Mill, reels of [illegible]t metal like this represen[illegible] millions of bearing rol[illegible] in long pieces. Later [illegible]e rolls are cut, shaped [illegible]d finished. Every process from the very productio[illegible] of the steel itself, is carrie[illegible] on in the great self-cont[illegible]ned Timken plant.

Miles of Might for Motor Cars

Reels of rolls! Thos[illegible]ittle rolls in the Timken Tapered [illegible]ller Bearings of your car are spun [illegible] the mile in the great Timken stee[illegible]mill. This is the mill with the la[illegible]est output of electric furnace steel i[illegible]he world. It is the only steel mill [illegible]rectly a part of the resources of a [illegible]earing plant.

What self-sufficient c[illegible]npleteness—what massive operation[illegible]—when bearings are hardly so m[illegible]ch as 1% of the weight of a moto[illegible]vehicle. But Timken Bearings so [illegible]rely improve cars and trucks that 13[illegible]000 Timkens per day are added to th[illegible] 150,000,000 of them already in use[illegible]

Permanence, silence, simplicity, and economy are the coveted characteristics which Timken Bearings assure in transmissions, in differentials, on pinion and worm gears, in rear wheels and front wheels, in steering pivots and in fans. Most largely responsible are Timken positive roll alignment, Timken capacity for both vertical and horizontal stresses, and Timken steel from Timken furnaces, as well.

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There is a mistaken idea in many men's minds that hard work is all that is necessary for success. Horses do hard work and get nothing but their board. Day laborers do hard work and remain day laborers always. Send for the book that gives the secret of *earning* more by *earning* more

At what rate do *you* run *your* brain?

DO you realize how much more *you* could *do* and *earn* if you gave yourself a real chance — if, for instance, you knew the secret of fifteen minutes a day?

Which of these men is most like you? The laborer, shoveling coal all his days? Or the skilled man, working hard for eight hours but making no real progress? Or the factory superintendent, who has a little more leisure and hope? Or the really big man, whose earning capacity has *no* limit, and who gets more interesting play and recreation into his life than all the others put together?

Said Emerson "Any man with an ordinary common brain can make good if he has the willingness to run that brain up to 80 per cent of its highest efficiency"

The secret of running your brain up to 80 per cent or more of its true capacity is no longer a secret, in the true sense of the word For over 400,000 ambitious people have learned it, and put it to work for themselves

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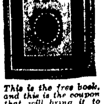

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I Sir Arthur says that I was belated in my discovery of the Murillo imposture, since he inserted a certain article in *Light* six weeks before my article was printed. But my article was in the hands of the editor two weeks before that, and, moreover, it was another picture which Doyle announced in *Light* that he detected, not the one to which I referred. My expression of wonder whether I was the first to discover the Murillo imposture had reference to the fact that it had passed the inspection of Doyle and many others long enough to get into the *International Psychic Gazette* Of course, I did not expect to be the only one who would ever make the discovery, nor did I regard the priority of mine as any part of the issue

Sir Arthur says that I misquote him; that he did not say that the picture was "the most remarkable spirit photograph" he had ever seen, but that it was "the most artistic." But I did not say that he said it, but that the *International Psychic Gazette* said he said it, which was true.

Thus, by magnifying details, and by wrongly relating them to me, attention is diverted from all that I deemed important, and all I emphasized, namely, that a clumsy and brazen photographic fraud passed the inspection of Spiritualists long enough to be reproduced as a proof of spirit action, in one of their prominent magazines, that Murillo's conception of the Deity was "recognized" by a woman as her "spirit guide," St John and that four of his conventional cherubs were "recognized" by four mothers as their respective children

(The *International Psychic Gazette* has since said that I ought to know that spirits are capable of making a "reproduction of existing paintings" In the present case this would mean that spirits carefully cut away two-fifths of the "Holy Family," and blocked out the betraying dove with cotton batting so thick that its edge casts a shadow I should say that if spirits are so anxious to prove their work a fraud they should be accommodated)

II. As to the fake spirit photograph shown in New York:

Sir Arthur tells us that in showing this picture on the screen he did not say it was genuine, and that he withdrew it after I communicated with him This is exactly what I stated in my article The reason I related the story was that I felt that such portion of the public as think that the distinguished novelist, since he invented Sherlock Holmes, must himself possess superior detective instinct should, in view of his bitterness against the (English) Society for Psychical Research and those who preserve its traditional policy of caution, recognize that he has an easy intellectual con science He knew nothing about the history of the fireman picture, and yet he showed it in his public exhibit of choice proofs And even now he says he is not sure that it is not genuine, although I let him read the original letters of Fallis, the Chicago photographer, who made it to prove to Dr Hodgson how easily a "spirit" photograph could be made.

I have stated what was the important point in connection with this part of my article. Again it is sought to divert attention from the real issue, and to fix it upon an irrelevant detail. Had it been shown that I had misstated a single detail, that would have been to the point. But no, it is intimated that I am not a gentleman, because I did not keep the matter a secret forever, as I kindly did at the time in order that the novelist's lecture tour should not be less successful I believe that, in connection with psychic research or this particular incident, whether I am a gentleman or not, like the question whether my nose is becoming, is an irrelevant detail. To be sure, I did not understand that I was obligated or expected to be forever silent on the little matter. I have no such secrets concerning myself, and anyone is at liberty to tell the truth about me at any time

It is not "prejudice" to state irrefutable facts, nor "unfair" to quote with exactitude, although I admit that "Dr Prince is always doing this kind of thing" But it is getting so that to have vision, memory and logical faculty enough to expose pretentious and blatant frauds is regarded by the resolute devout as evidence of a soul filled with all iniquity

Walter Franklin Prince.

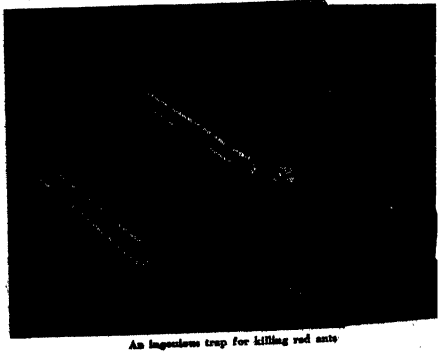
Kill the Ant!

Here is a clever device, guaranteed to catch and kill red ants. Our correspondent describes the process by which these pests climb up the perforated spout, there to fall off to their death.

A trap guaranteed to catch and kill red, cutting ants has been invented by a Texas man. The trap is a square trough, about an inch deep, with an elevated spout at one corner. The ants climb up the spout and fall into a pan of kerosene oil which kills them. The device, which occupies only a square foot of space, is set by being intrenched around the hole in such a manner that the insects fall into the trough either when leaving the hole in search of food or when returning after foraging.

In setting the trap, care must be taken to bank the dirt up against the sides so that the ants will tumble in when trying to enter or reach their bed The curved tin sides prevent the ants climbing out, while the perforated floor of the spout makes it possible for them to ascend it with ease, only to fall into the oil The accompanying picture shows one of the traps set around an ant bed, with hundreds of dead ants piled up near the cat. Several holes in the bottom of the trough will provide escape for rain water that might fall in it The trap is not guaranteed to catch small sugar ants which, because of their size and light weight, can climb out

These traps are made of ordinary sheet tin covered with a coating to make it



An ingenious trap for killing red ants

slippery. Pieces are first cut for the sides and spout on a standard cutting knife. Then these pieces, cut in exact sizes, are run one at a time through a series of machines operated by hand cranks. Each machine performs a specific operation, such as perforating the bottoms, bending the sides, and cutting a hole in one side for the spout Sector gears, cutting dies, scavenger springs and heavy weights are the principal parts of the machines, which were also invented by the inventor of the trap. After the pieces have been cut and bent into shape, they are soldered together to form the completed trap.

Lee Woods.

A Novel Fertilizer

One of our friends in Guatemala sends the following: Radio fans may be interested in figuring out just what reaction takes place in the gap between the ground and the end of the antenna

Editor, Scientific American:

You may be interested in the experiments I have been making in stimulating plants by means of electricity from the atmosphere.

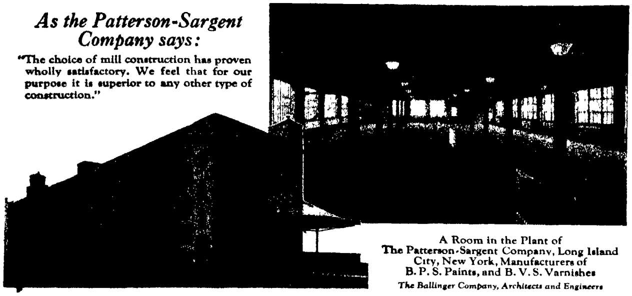
The lime tree which was rejuvenated by means of atmospheric electricity

Plants are natural lightning conductors, as the points of the leaves and needles place themselves in electrical connection with the atmosphere After each electrical storm it may be noted that the plants obtain new vigor and growth. Therefore, if the stem and branches of the plant are provided with copper wires adjusted in two or three places by means of narrow copper bands and if the upper ends extend toward the atmosphere in the form of small lightning conductors, the plant remains in direct contact with the electricity of the atmosphere and will be stimulated in such a way that it will produce a great quantity of new flowers and fruits The fruit is of far better appearance and of better quality on account of this device

My first experiment was made with a young guava tree After having placed an antenna on this tree during the months of March to June of this year it made several new shoots, it has flowered and produced fruit twice and the fruits are twice the size of the ordinary fruit and are much sweeter. During these months we had many electrical storms.

On the 15th of July of this year I experimented with an old lime tree The fruits of this tree were dried up before they were much good. In order to obtain a better result I placed three antennas of copper wire in the tree, also surrounding some of the branches and also I placed an antenna of loose copper wire. These antennas consisted of 50 turns around the main branch just above the trunk and extended down the trunk to a point just above the ground. By means of these four antennas the tree started to make new growths within fifteen days after a storm; on the present date (the 15th of October) it has produced many new shoots and the fruit has improved noticeably, is juicy and sweet. At present on the tree are flowers and fruits of all sizes and it continues to flower and produce fruit. The tree is completely rejuvenated.

Jose Gallegos.



As the Patterson-Sargent Company says:

"The choice of mill construction has proven wholly satisfactory. We feel that for our purpose it is superior to any other type of construction."

A Room in the Plant of The Patterson-Sargent Company, Long Island City, New York, Manufacturers of B. P. S. Paints, and B. V. S. Varnishes

The Ballinger Company, Architects and Engineers

Every Manufacturer whose business demands utmost flexibility of internal plant arrangement should read this —

The Popularity of the Mill Construction Building Is Enhanced by the Ready Availability and Fine Structural Qualities of Douglas Fir

An increasing percentage of the big timbers and plank required for all general construction purposes are being supplied today in Douglas Fir from the Pacific Northwest.

From the fine structural qualities inherent in the species, scientific selection makes it possible to secure, *on special order*, where exceptionally heavy loadings demand it, a "select structural grade," the equal, if not the superior, of any structural wood on the market today.

Through the Weyerhaeuser distributing plants at Baltimore and Minnesota Transfer, Saint Paul, Douglas Fir in all standard grades and sizes can be laid down quickly and economically in every industrial section of the country.

Twenty-two percent of all the lumber produced in this country today is Douglas Fir.

Quoted by Permission from letter of

THE BALLINGER COMPANY

Architects and Engineers, New York

"With reference to the Patterson-Sargent project, a marked advantage that mill construction has over masonry construction — the ease with which alterations can be made—was a matter of primary importance in the manufacture of paints and varnishes. Alterations or extensions of the plant equipment almost invariably involved changes in the rather elaborate system of pipes through which the material flows. Mill construction permits the perforation of the floors for new piping at practically any point at a small cost."

BUSINESS men who know the importance of keeping down plant overhead are paying more and more attention to the adaptabilities and *economies* of heavy timber *mill construction* for factory and warehouse expansion.

It is the business of the architect and engineer to advise you whether Mill Construction is adaptable to your individual building requirements. Or, if you prefer, there is available the consultation of a Weyerhaeuser Expert Construction Engineer.

The advantages of "Mill Construction" and the structural quality of Douglas Fir are thoroughly covered in the Weyerhaeuser booklets "Industrial Buildings" and "Structural Timbers of Douglas Fir" and in "Technical Note No. 201" issued by the U. S. Forest Products Laboratory. These booklets will be sent on request to responsible members of industrial concerns.

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Perhaps you, too, can cut your "B" battery costs in half. Just follow the chart. It gives you the secret of "B" battery economy

THOUSANDS of people have made this discovery. Eveready "B" Batteries, when used in the proper size and with a "C" battery*, are the most economical, reliable and satisfactory source of radio current.

On sets of one to three tubes, Eveready "B" Battery No. 772, used with a "C" battery, will last a year or longer, usually longer. On sets of four and five tubes, either of the larger Heavy Duty Eveready Batteries No. 770 or No. 486, used with a "C" battery*, will last eight months or more.

These figures are based on the average use of receivers, which a country-wide survey has shown to be two hours daily throughout the year. If you listen longer, of course, your batteries will have a somewhat shorter life, and if you listen less, they will last just that much longer.

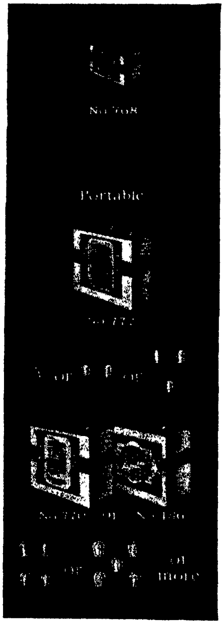
Here is the secret of "B" battery satisfaction and economy:

With sets of from 1 to 3 tubes, use Eveready No. 772. With sets of 4 or more tubes, use either of the Heavy Duty Batteries, No. 770, or the even longer-lived Eveready Layerbilt No. 486.

Use a "C" battery on all but single tube sets.

Evereadys give you their remarkable service to the full when they are correctly matched in capacity to the demands made upon them by your receiver. It is wasteful to buy batteries that are too small. Follow the chart.

In addition to the batteries illustrated, which fit practically all of the receivers in use, we also make a number of other types for special purposes. There is an Eveready Radio Battery for every radio use. To learn more about the entire Eveready line, write for the booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you on request. This booklet also tells about the proper battery equipment for use with the new power tubes. There is an Eveready dealer nearby.



*NOTE. In addition to the increased life which an Eveready "C" Battery gives to your "B" batteries, it will add a quality of reception unobtainable without it.

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WSAI–*Cincinnati*
WEAR–*Cleveland*
WWJ–*Detroit*
WGN–*Chicago*
WOO–*Davenport*
WCCO { *Minneapolis* / *St Paul*
KSD–*St Louis*
KGO–*San Francisco, 8 P. M. Pacific Coast Time*

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Wide World

A waterproof radio transmitter has been designed especially for use in lifeboats. The operator's hand and arm are covered by a canvas bag which keeps water from entering the waterproof cabinet

Is Radio Menaced by Strange Rays?

RADIO followers, who have been reading in the papers of the new scientific discovery of wild and powerful rays travelling from the "depths of outer space" toward the earth with the speed of radio, are likely to wonder what effect they will have upon broadcasting and the ether.

The extremely short length of these immigrant waves, of 10,000,000-volt variety, which is estimated to be much shorter than X-rays, is "unimaginable," says Dr R. A Millikan, discoverer of the rays, who has been probing and studying nature's secrets upon the edge of finite space. So powerful is their energy after they penetrate the upper regions of the atmosphere that it is estimated Old Mother Earth might experience a disastrous effect should the number of rays increase

Dr. Millikan reports that these rays come from space and bombard the earth from all directions at all times, and that they have extraordinary penetrating power.

Will they, like the sun's rays, menace radio by absorbing its strength?

There is no doubt that the rays of Old Sol are responsible for the limited range of radio concerts in the daytime This is proved by the fact that as soon as twilight blends into darkness the distant stations begin to come forth from loudspeakers hundreds of miles away, and as the night progresses the waves span greater distances, with increased intensity. Then come the first faint traces of dawn in the Eastern sky and the distant transmitters begin to wax and wane, suddenly vanishing, producing at sunrise a death-like silence in the radio realm.

Radio experts explain that the ultra-violet rays and other beams radiated from the sun penetrate the atmosphere and act as millions of antenna, absorbing radio energy, or serve as a pathway over which Hertzian waves reach the ground before they have an opportunity to seek an antenna. One might picture this effect of the sun's rays as a curtain made up of myriads of wires stretched from the sky to the earth, but when darkness sets in the curtain rises and the radio theatre is opened on a national scale. It is then that receivers in New York skyscrapers can be put in tune with melodies played out where the corn grows tallest.

What would man do if these immigrant waves increase in number and have an ill effect upon the ether? All radio might vanish and the great radio industry which grew "over night" would crumble What assurance has man that the ether will always remain to vibrate with human thoughts and emotions? These strange rays might wipe radio out over night and several have suggested that man himself will destroy the ether, because with millions of receiving sets tapping the invisible, odorless, tasteless substance, it may finally be used up Others dispell such fear and contend that the ether is an everlasting supply and will occupy all space until doomsday

Others point out that these new rays may be signals from another planet and they add weight to this contention by calling attention to the fact that the mysterious waves are extremely short in length This shortening of wavelengths seems to be the trend radio is following in its earthly development as amateurs talk from nation to nation, across continents and over seas, on short wavelengths propagated by less power than is required to operate an electric iron. If a boy can do this from the attic of his home, why could not some race of superior development devise a system of short wave communication far more effective and powerful than man has discovered on earth? Undoubtedly, 1,000 years hence, the earth's inhabitants will look back upon our radio of today as only a crude and tiny link in the chain of their ultra and inter-planetary broadcasting system. Perhaps these nomad rays, which are being wafted in from the infinite, are transporting motion pictures of other worlds, but we are so far behind in radio science that they cannot be flashed upon earthly screens.

Some say that there is no cause for alarm because no one seems to be sure that there is such a medium as the ether. It is an established fact that the air is not the basis of radio, so there must be another medium; and scientists have named it the ether. They tell us that the ether occupies mountains, that it exists in a vacuum, in our bodies and in the walls of our homes, and that

Wide World

Owners of receivers in Japan pay a fee amounting to about eighty cents a month to the Tokio municipal station. The sets are sealed on this one wavelength so that the operator cannot tune in another broadcaster

is why indoor antenna intercept radio broadcasts Did you ever stop to think that, no matter where you are, housewives' talks, symphonies and jazz, sermons and news, pass through your body at the speed of sunlight, 186,000 miles a second. Whatever this peculiar medium is, it seems to be everywhere!

Charles P. Steinmetz startled the radio world shortly before he died by declaring that there were no ether waves! He argued that radio and light waves are merely properties of an alternating electro-magnetic field of force that extends through space. Steinmetz said that the conception of the ether is one of those hypotheses made in an attempt to explain a difficulty, and the more it is studied the more unreasonable and untenable it becomes.

Sir Oliver Lodge, on the other hand, is a staunch defender of the ether's existence He believes that, because the ether is invisible is no reason for saying that it does not exist. Those who agree with him point out that man and animals breathed the air for thousands of years before the chemical constituents were known or even that the air had weight. A barometer was needed to prove that fact. If it required centuries to learn about the air, why cast aside theories regarding the ether or worry that it may be destroyed by some outside force? No instrument has been discovered to prove that the ether exists. It remains one of the mysteries of God's handiwork along with radio and the Millikan rays.

Broadcasters Using Powerful Tubes

A NEW 10-kilowatt vacuum tube, which vibrates at the rate of 5,000,000 times a second and requires for operation at full capacity as much current as would be used to light every room in a dozen six-room dwellings, is now in use at KDKA, WBZ, KFKX and KYW The tube uses a voltage that is twenty times as high as traction companies use to propel street cars

This tube handles so much energy that it has been impractical to build a base that would not be burned up if all the filament, grid and plate leads were run through the base. Consequently, the leads are taken off at different places – the filament wires at the bottom, the grid lead at the side and the plate wire at the top

The tube stands a foot and a half in height A water jacket carries off the heat created when the 15,000 watts of energy are applied to the plate

The plate is a copper tube nine inches long and an inch and a half in diameter, closed at one end Almost the entire length of the plate protrudes from the top of the tube. The water jacket is fastened to the plate and water is circulated under pressure to absorb the heat The column of water is about twenty feet long The hose is half an inch in diameter The amount of current which leaks away to the ground through the column of water is negligible. The resistance of water to the flow of electrical current is more than a billion times that of a

Keidel & Herbert

Tuning a ship's radio aerial system. The wavelength on which the S.S. *Gripsholm* operates can be quickly changed by this unique layout of taps

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Steel Sheets that *Resist Rust!*

THE destructive enemy of sheet metal is *rust*. An alloy of copper gives to Steel Sheets and Tin Plates the highest degree of resistance to rust and corrosion. Keystone Copper Steel gives maximum endurance—a fact proved by actual time and weather tests. Demand Keystone quality for lasting service.

Apollo

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APOLLO-KEYSTONE *Copper Steel* GALVANIZED SHEETS
CULVERT, FLUME AND TANK STOCK
FORMED ROOFING PRODUCTS

Black Sheets for all Purposes

AUTOMOBILE SHEETS—ELECTRICAL SHEETS
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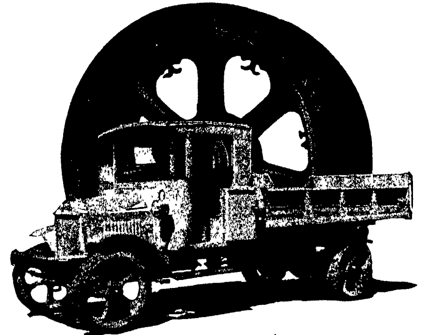

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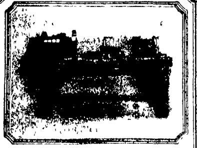

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copper cable of the same length and diameter Thus, by water cooling, the output capacity of the vacuum tube has been increased to 10,000 watts, sufficient power to light 200 ordinary 50-watt lamps Several of these tubes can be used in parallel to produce greater power than 10-kilowatts.

Radio Sets on Farms Growing in Number

THERE are close to 600,000 radio receivers on farms in the United States, and the number is rapidly increasing The farmers' appreciation of broadcasting is seen in the fact that there has been a 300 percent increase in radio sets on farms since 1923. Dealers in various parts of the country report that the farmer generally buys a high class set, costing between $125 and $400

Twenty-four agricultural colleges maintain broadcasting stations; and they cooperate with the Department of Agriculture in sending out weather, crop and market reports.

Tests Show February Best for Radio

OBSERVATIONS made by the Bureau of Standards on the waves of KDKA revealed the following results· The worst atmospheric conditions were experienced in June and the February air seemed to be superior to that of all other months. The next best months were in order, March, January, November, December, May, October, April, August, July and September.

The worst fading was encountered in October and the least in February, with fading increasing in the following order· April, July, March, June, January, May, November, December, August and September

Big Radio Market in Chicago

ALTHOUGH there are approximately 686,000 homes in Chicago, it is estimated that there are only about 100,000 receiving sets in operation in that city

When to Tune in Cuban Stations

STATION 7SR, Elia, Cuba, will be on the air at 8.30 P M , Eastern Standard Time, every Tuesday and Thursday up to May 1st The transmitter is rated at 500 watts and the wave is 295 meters Station PWX, Havana, is on the air Wednesdays and Saturdays from 8:30 to 11:30 P.M., Eastern Standard Time, and can be heard on the 400 meter wave. Station 6KW, Tuinucu, broadcasts every day from 8:00 to 10:15 P.M , Eastern Standard Time. It can be found on the 338 meter wave. The transmitter is rated at 500 watts on week days, and 6,000 watts on Sunday nights.

Radio Sets' Total Nears 5,000,000

IT is estimated that there are now about 5,000,000 radio sets in operation in the United States. There are approximately 22,000,000 homes in this country so the radio market is still very large. The total for radio is small compared with the 18,000,000 automobiles, about 15,000,000 telephones and 12,000,000 phonographs.

Five Loudspeakers in One Set

A NEW receiver named the "Zeniphonic" has been introduced by the Zenith Radio Corporation of Chicago It is a ten-tube circuit, equipped with five stages of radio frequency amplification. There is only one dial, and it tunes over a range from 80 to 600 meters The ordinary tuning range is from 180 to 600 meters, but it is quickly lowered by throwing a small switch inside the cabinet The purpose of this wide tuning range, according to officials of the company, is to make provision for what they believe to be an inevitable development in broadcasting, that is, the extension of the broadcasting wave band below 100 meters. Several of the models are equipped with two loudspeakers, which give a balance between the high and low tones The most expensive model has five loudspeakers, to insure high quality of tone

Predicts Six Companies Will Control Radio

COMMENTING upon the increase in radio sales, Alexander Eisemann, Treasurer of the Freed-Eisemann Radio Corporation, said that in his belief 95 percent of the radio business will be done by less than six companies. He pointed out that at the present time 90 percent of the automobile business is done by twelve companies

"The larger units in the radio manufacturing business now well established will

Fotograms

The *S.S. Gripsholm*, the electrically driven Swedish liner, has a two kilowatt spark set which carries 500 miles in daylight. At night the range is greater

Kadel & Herbert

The radio receiver on the *S.S. Gripsholm*. The circuit has a tuning range of from two hundred to three thousand meters

grow bigger, and there will undoubtedly be considerable mortality among the smaller units, just as was the case in the phonograph business years ago It is very evident that five or six companies whose position as to product and merchandising policies is well entrenched, are growing stronger and stronger, and that within a very few years the bulk of the business will be concentrated in comparatively few hands New capital is no longer rushing into the radio business as it formerly did," says Mr. Eisemann.

Fotograms

The new liner *Berlin* is the first ship to be equipped with radio telephone booths for the use of passengers. The booths are connected with the ship's radio room, much like a regular telephone switchboard. Passengers can talk to other ships within a few hundred miles

A Radio Puzzle for Home Builders

The architectural and engineering bureaus of the National Lumber Manufacturers' Association declare that the general use of radio in the home has precipitated a new and perplexing problem for builders It appears that, co-incidently with the popularity of broadcasting, a new form of exterior wall construction was widely introduced, especially in Florida, other parts of the South, California and the Southwest. In taking advantage of the mild climate in those regions, and for the purpose of reducing building costs, people have adopted skeleton-surfaced houses, eliminating shingled walls, but substituting stucco-surfaced siding Generally, the wooden framework of the house has no lumber sheathing. Instead, metal lath or chicken wire is applied directly to the studdings, and then the stucco is plastered over the webbing This metal network creates a shield for radio waves and prevents Hertzian impulses from reaching indoor antennas or loops, which are popular in southern climes because they are not exposed to intercept as much static as an outdoor wire

Some lumber dealers throughout the South are taking prompt advantage of the metal lath shields and are encouraging all lumber homes It is pointed out that a receiving set located in a house shielded by wire or metal lath will not be shielded providing an outdoor antenna is employed. It is the antenna that intercepts the energy from the ether, and if it is not shielded the receiver attached to it will work all right although it may be in an all metal compartment

Overcoming Changes in Aerial Capacity

John Hays Hammond Jr., has invented a means of compensating for variations in the capacity of an antenna circuit caused by changes in the effective height of the wire Such changes might be effected, for example by the roll or tipping movement of a ship to which the antenna is mounted

College Station Acts as Relay

Reliable and consistent radio relay of broadcast signals up to 300 miles is best obtained on long wavelengths, according to tests made between WGY and WCAD, St Lawrence University, Canton, New York The operators at the college station intercept the programs from Schenectady, broadcast on the 1,560 meter wave

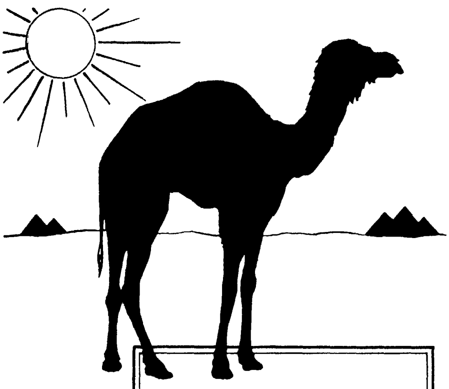
All programs of WGY are radiated on 379.5 meters, 41 88, 109, and 1 560 Observations of the transmissions on each wave length are made Experiments in relay work between WGY and WCAD indicate that 1,560 meters is superior to such waves as 40 meters or 100 for relay purposes

15,110 Amateur Stations

There are now 15,110 amateur transmitting stations licensed in the United States The number has decreased since last year when the number totaled 15,450.

Miniature Station for Testing

One of the smallest practical broadcasting stations is in use at the King Quality Products radio plant at Buffalo, New York. It was put into service to meet an insistent demand for morning broadcasting so that sets at the factory could be tested, despite the fact that the regular broadcasters were off the air. The miniature station is mounted on a panel eight and one-half inches square, and it is attached to a phonograph The transmitter's wavelength range is from 200 to 600 meters and can be heard in the area of a city block.



This Arguto Bearing was in constant use on the countershaft of an 18-inch Lodge & Davis engine lathe for twenty-two years and when taken down showed only .0125" wear with not a cut or scratch, and an inner surface polished — like a mirror

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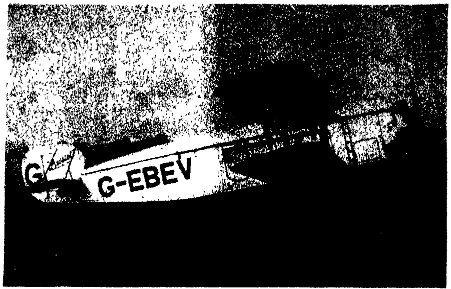

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The Bristol *Pullman*, an interesting ten-passenger airplane, equipped with a Lucifer 400-horsepower, air-cooled engine

The Bristol "Pullman"

THE possibilities of multi-engined planes while great have not by any means caused the disappearance of the single-engined air transport The simplicity of the single-engined power plant and the greater efficiency of the single-engined plane which has no inefficient head-resistance-producing engine nacelles to pull through the air have left many adherents of this type of plane For example, the Bristol *Pullman*, with only 400 horsepower in its single Lucifer engine, can carry ten passengers through the air at a speed some ten to twenty miles greater than the Farman *Jabiru* or the Bleriot "quadri moteur" which with 720 horsepower can only carry 12 passengers

The efficiency of the single-engine type is particularly marked when an air-cooled engine is employed and the weight of radiator, and water in engine and radiator are saved In the *Pullman* the front of the fuselage is skilfully rounded off and little of the air-cooled engine is actually exposed to the blast of air The pilot sitting high in the fuselage has a vision which is quite as good as in the four-engine jobs where there is no engine ahead; and it is undoubtedly easier to watch one engine and one set of engine instruments than it is to watch the switchboard of a multiple-unit power plant.

At the present time passenger comfort is being carefully studied by both American and foreign designers. One of the signs of this increasing care for the passengers is in the long exhaust pipe carried by the Bristol *Pullman*. This pipe is at least twenty feet in length and is carried far behind the passenger compartment. The pilot still has somewhat of a climb on the outside ladder to get into his cockpit; the passengers have to mount but three or four feet off the ground

The photograph of the interior of the *Pullman* emphasizes the care now lavished on the passenger cabin The passengers are seated on roomy, well-upholstered seats Each passenger can see a clock, an altimeter and an air-speed indicator ahead of him and can tell thereby where he is, how high he is and how rapidly he is reaching his destination—not with the accuracy of the navigator, but with sufficient accuracy to satisfy natural curiosity There are no crosswires or beams of any description in

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Interior of the Bristol *Pullman*. The passengers are seated on comfortable seats, the windows can be completely opened and the instruments at the end of the cabin tell the airplane's speed and height

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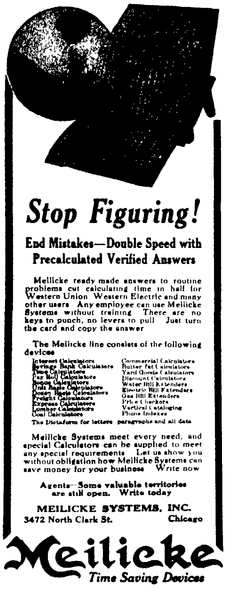

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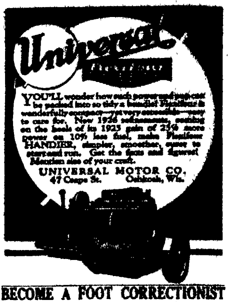

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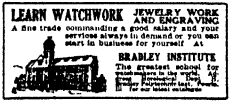

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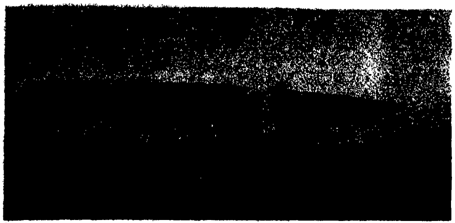

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The Farman *Jabiru*, a four-engined monoplane carrying twelve passengers, with two engines in tandem on either side of the fuselage

the cabin, and each window can be wholly opened if desired. In cold weather special arrangements for tapping the exhaust allow the cabin to be comfortably heated.

Four-Motored Airplanes

A GREAT many aircraft operators are agreed on the necessity of multi motored airplanes in air transport to provide the greatest safeguard against power-plant failure. The British Air Ministry has encouraged the construction of a number of three-engined planes, Junkers and Fokker have each produced passenger carrying craft, equipped with three engines French constructors have gone even further in this direction by building four-motored planes

The basic advantages of using four engines instead of three are: 1 The greater security against power-plant failure; when one engine of the four goes out of commission the loss of power is unimportant as far as ability to continue the flight is concerned and even if two engines go out of commission, the plane should be able to reach its destination, although with some difficulty (whereas the failure of two engines on a tri-motored job means a forced landing even though the glide downwards may be very gentle). 2 The even number of engines employed allows the disposition of two engines on either side of the central fuselage, frees the passenger carrying fuselage of gasoline tanks and minimizes the danger from fire to the occupants in case of a crash

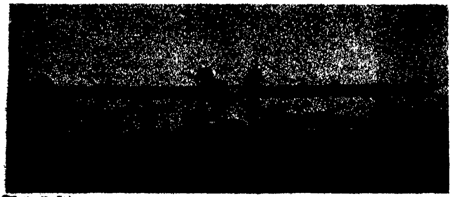
The use of four engines involves certain special difficulties, however. The more engines employed the greater the complexity of the power-plant and instrument system It is quite a task to keep four engines running smoothly together, and the engine instrument board requires as much careful study as the switchboard of a large power station on the ground. Also, it is difficult to arrange the four engines so as to maintain both aerodynamic and propeller efficiency

As the photographs indicate, Farman and Blériot have arranged the engines of their respective designs in radically different ways

The Farman *Jabiru* is equipped with four 180-horsepower Hispano-Suiza engines The pilot and his mechanic sit at the front end of the fuselage, at its very top, so that their vision is almost perfect in all direction Two powerful headlights in the front of the fuselage are useful for a night landing The thick wing monoplane is free from excess of bracing and has a span of 62 feet A speed of over 100 miles per hour is obtainable and a climb to 13,000 feet in 37 minutes The deep fuselage provides a very comfortable cabin for 12 passengers with toilet and baggage compartment in the rear. The engines are supported on a short stub wing fastened to the bottom of the fuselage, which has considerable lifting capacity The engines are arranged in tandem in a very neat nacelle, with the gasoline tanks between each set of engines so that the head resistance of the power plant is not too great. But there is real difficulty in the design of the propellers The rear propeller works in air already disturbed by the front propeller, also, since it is in the slipstream of the front propeller, it is attacking air which is moving faster than the airplane, while its effective thrust is still acting with only the speed of the plane Therefore, the efficiency of the rear propeller is lower than that of the front propeller (some improvement is effected by making the pitch of the rear propeller greater than the pitch of the forward propeller)

In the *Blériot* 115, which is also equipped with four Hispano-Suiza motors of 180 horsepower each and likewise carries 12 passengers at a speed of over 100 miles per hour, a biplane structure is adapted with each engine in an individual nacelle. The disadvantage of the tandem propeller arrangement disappears, but other difficulties present themselves The projected area of the power plant nacelles is now twice as great as in the Farman *Jabiru* Another difficulty is the very high thrust of the *engines, mounted on the upper wing* If, on taking off, the lower engines suddenly fail, a disastrous nosing over of the ship is almost a certainty Even in the air the pilot must be prepared to meet sudden and powerful changes in balance conditions if one of the upper motors fail Yet in practice, the Bleriot is flying quite satisfactorily It is being used on the Paris-Strasburg Warsaw and on the Paris Strasburg Vienna Constantinople airlines

In all probability, the ultimate solution of the multi-engine problem will be the provision of several motors in a central fuselage, working on one propeller, but provided with clutches so that any motor can be thrown out of the system at will. Minimum head resistance and ability of the mechanic to overhaul any unit that is out of commission are powerful incentives to experimenters



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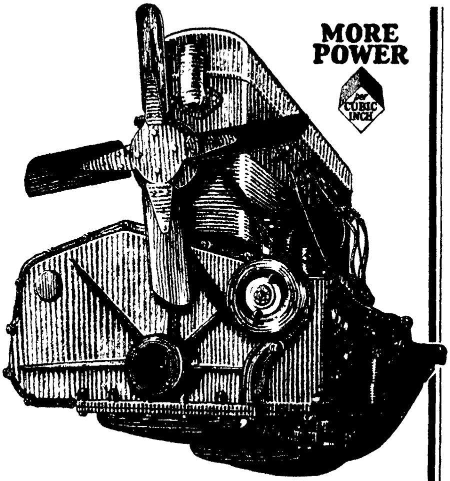
The Blériot 115, which illustrates another system of disposing of the engines in a four-motored plane



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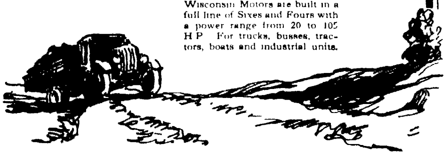

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In the third place the mechanical cost of printing and binding and distribution has been reduced by quantity production We all know that the cost of the Ford car has been reduced by the same means What business men call the 'overhead' is divided up into so many fragments by the number of volumes that each volume bears a very small share of it

Now it is to this overhead that is charged a great part of the cost of collecting the information and putting it into a concise clear and interesting form And this is where all the money was spent that needed to be spent to make this extraordinary encyclopedia what it is Saving there by scrimping was not necessary And so owners of this encyclopedia have in a convenient form a body of information conveniently arranged so abundant that I am surprised it can be put into such space I do not know where an equal amount of general information can be found in the same compass I certainly do not think it can be found anywhere at such a price

All human work is fallible I suppose there are errors in this But the high standing of the men who are responsible for the editing of it is warrant for the high quality of the scholarship that is represented in it The information is modern covering events as late as 1924 presented with extraordinary impartiality based upon recent facts and conclusions of science history and other departments of human knowledge Hereafter I shall have it at hand, and in most cases it will be the first encyclopedia to which I shall turn

I should like to tell you more about the encyclopedia itself It is a sort *of Who's Who of living celebrities* as well as *of the distinguished of all times* Its more important articles are well worth reading for their own sake as well as for the purpose of reference I do not know for example where else one can find such a survey of the World War or such an account of the automobile with not only such a story of its past and such a description of its essential parts but such a peering into its future, or such bird's-eye views of recent events like the rise of the Irish Free State

If I could send a gift to every household with which I am acquainted, I think I should choose this set of five volumes of the New Universities Encyclopedia No matter what other encyclopedias one may own, there will be a use for this to which no other could be put For the student in school or college it affords quick access to the main facts of any subject he would like to look up For anyone whose time is limited this encyclopedia is particularly welcome, because it does not require search through long articles for outstanding facts

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A Sleeve Valve for Use in Aero Engines

POWER-PLANT failures, according to British statistics, account for from 21½ to 50 percent of flying unreliability. The sources of power-plant failure are themselves analyzed as follows 28 percent in the water system; 19 percent due to valve breakage; 10 percent in the oil circulation system, with the remaining 43 percent accounted for by actual breakage of materials in the crank-case, housings, and so on.

The readiest way to get rid of water-system troubles is to use air-cooled engines. To meet the valve problem, the British are resorting to a well-known automobile device and building a sleeve-valve aero engine similar in principle to that employed in the Willys-Knight automobile.

Safety in Air Transport

IN a presidential address before the Royal Aeronautical Society, Major General Sir Sefton Brancker reviews six years' experience of British air transport, now concentrated in one company, the richly subsidized Imperial Airways.

Sir Sefton summarizes the sources of dangers as follows: a, breakage of the aircraft itself in the air; b, jamming or failure of the controls; c, fire, d, engine or installation failure over heavy sea or country where a safe landing is difficult or impossible; e, error of judgment or sickness on the part of the pilot, and g, collision either in the air or on the ground

This list of possible dangers looks formidable, yet actually, the number of fatal accidents in British air transport since its inception is only five, and, for every source of danger, a safeguard or a line of investigation leading to a safeguard is readily available.

Modern airplanes seldom break in the air and there is practically no air strain which they cannot meet, if up to designed strength With wooden airplanes, however, the possibility of deterioration and of resulting weakness *in some vital part* is always present Therefore, the development of metal construction for every part of the airplane is advocated

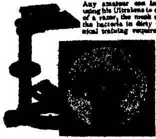
There is no excuse for the failure or jamming of the controls Correct mechanical design and careful inspection should eliminate this entirely

As regards possibility of fire, General Brancker is optimistic "I think that it is fair to say that in a well tried-out machine, properly looked after, the danger of fire in the air is negligible The danger involved by the remote possibility of a gasoline pipe breaking is guarded against by the provision of fireproof bulkheads between the engine and the crew and cabin . The danger of fire in case of a crash is admitted, but can be reduced to the minimum by the careful placing of tanks and the avoidance of pressure systems of gasoline feed"

To guard against the dangers of engine failure over unpromising territory, the General gives the following advice to engineers *and designers: They must devise and install* an infallible power plant even at the cost of extra weight and extra expense

The British seem to speak rather loosely of error of judgment by the pilot If a plane crashes, following a power plant failure or bad weather, the cause of the accident may be given as "error of judgment!" Almost no weather is too bad to fly in High winds which have stopped the crossing of the Channel steamers between Dover and Calais have not prevented the flight of airplanes between London and Paris But there is a strain on the pilot in such conditions, which may lead to mistakes and "errors of judgment." The remedy lies in the design of airplanes of greater stability and easier maneuverability.

Collision may mean collision on the ground or collision in the air. The air seems to be vast enough for innumerable aircraft to fly without ever meeting, yet collisions have occurred in foggy weather at busy airdromes. The suggested remedy is, "the evolution of some form of automatic fog signal."



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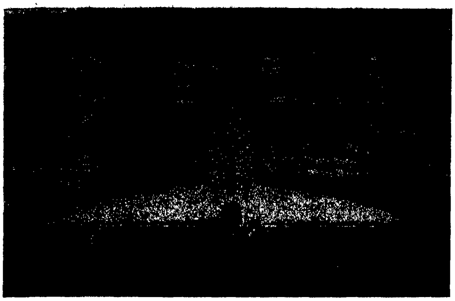


Static test of the 1925 Curtis Racer

Destroying for Safety

IN the design of airplanes, refined methods of strength calculation are employed—perhaps more refined than in any other branch of engineering In the design of a bridge uncertainty as to strength calculations is met by adding more metal to the girders and no very great harm is done The airplane has to meet far more rigid requirements as to weight. The simple expedient of piling on steel is not permissible Hence, for airplanes of a novel type, particularly for pursuit airplanes in which the pilot can by skilful and violent maneuvering impose great strains on his craft, reliance is not placed entirely on the engineer's calculations.

Static testing or sand testing to destruction is resorted to Our photograph shows the static test of the wings of the 1925 Curtiss racer. It will be noted that the wings are upside down in the test In the air the forces on the wings act *upwards* The sand bags or lead-shot bags can only exercise forces downwards under gravity—hence if flying conditions are to be simulated, the wings must be upside down

In a sand test the distribution of the bags on the wings simulate air pressure as far as possible The bags are carefully arranged on the floor to represent so many loads. As each unit load, representing approximately the gross weight of the airplane is applied, the wings are slowly released from supporting jacks and deflections at various important points are carefully measured The jacks also prevent the complete collapse of the wings when a failure does occur, so that the observers can see the exact character and extent of the failure By such methods extraordinary advance has been made in securing large factors of safety for airplane structures

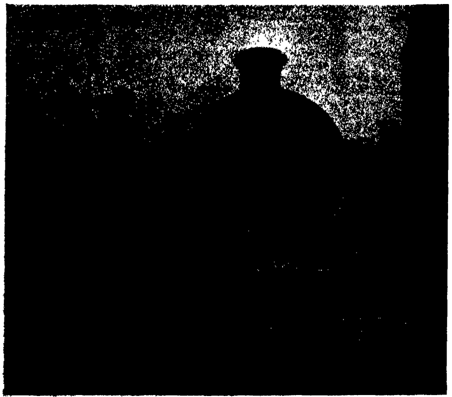
During the war single seater pursuit ships were constantly flown with factors of safety of only five or six Now machines with factors of safety of fifteen are being built, yet with structures so light that the highest performance in speed and climb is nevertheless obtained

A Contrast

ENGLISH locomotives appear ridiculously small to American eyes, efficient though they are Still they form a striking contrast in size with aero engines of equal power Witness the *Cuffley*, an express locomotive of 1,000 horsepower and weighing 318,000 pounds, and the Napier Cub Aero engine, which with its four banks of four cylinders, delivers 1,000 horsepower likewise, but weighs only 2,300 pounds

Lessons of the World Flight

THE "First World Flight" (written by Lowell Thomas, published by the Houghton Mifflin Company of Boston) makes fascinating reading Lowell Thomas is a well-known explorer and he has made a splendid story of "the personal narratives of Lowell Smith, Erik Nelson Leigh Wade, Leslie Arnold, Henry Ogden, and John Harding," the six young Army Air Service



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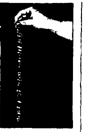

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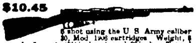

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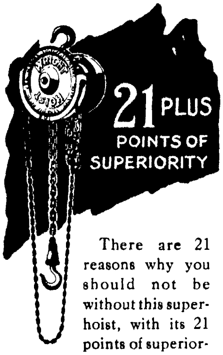

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lieutenants whom he accompanied in a friendly plane for thousands of miles At the time that these dashing young aviators were circumnavigating the globe, we thought our interest had been killed forever by an abundance of front-page news stories But now, nearly eighteen months after the glorious feat, we read this book with full interest Besides the personal interest and the sense of adventure the book leads to certain conclusions which bear on the development of world air transport

It is true that the world flight occupied 172 days, and that the fliers had the most thoroughgoing and skilful support of their own government and of the governments of twenty two other countries. Nevertheless, the fact remains that with proper preparation a plane can fly in every part of the globe and in every kind of weather As well as good planes and good pilots, air transport needs meteorology, and more meteorology It was only by months of expert study of winds and other weather conditions that the flight was made possible

Planes must be supported by the most careful ground organization An instance of this is in the wonderful arrangements made by the Air Service in providing all over the globe boxes containing spare parts for planes and engines, small quantities of standard utility parts, material such as tubing, shock absorber cord, plywood and so on, with the boxes themselves constructed of ash, spruce and plywood to serve for possible repairs

The instinctive flier who relies only on his skill and sense of balance must yield to the ultra-scientific pilot who can handle the following formidable collection of instruments: the tachometer, the air-speed indicator, the ampère-meter, the volt-meter, oil-pressure gauge, gasoline pressure gauge, altimeter, an ordinary airplane compass, an earth inductor compass, a bank-and turn indicator, comprising two small gyroscopes for flying in fog, six gasoline-control valves, altitude controls, to change the proportions of gasoline and air fed to the engine at varying heights, and an engine primer for starting in cold weather—and this is not the complete list of instruments carried by these practical men

The physical well-being of a pilot is as important as his training in flying and navigation Before the long journey, both pilots and mechanics devoted several hours a day each to calisthenics, medicine-ball, tennis, basketball and road work, as though they belonged to a football squad!

The importance of detail in the power plant is forcibly illustrated by the mishap occurring to Leigh Wade in the early stages of the trip when, because a drain-cock had vibrated and broken loose, he was forced to make a bad landing near the Sacramento River

The effect of tropical heat on the air and the consequent inability of a plane to get aloft when fully loaded, the effect of intense heat on fabric-covered wings, the difficulties of fog flying, the dangerous effects of the wash of the propeller on a following plane, the hazards of mooring seaplanes in unsheltered seas, are a few of the technical points which the journey brought to light or emphasized

An interesting book of adventure is thus, as well as a source of useful information on the general art of aviation

Landing at Night

LANDING safely on an airdrome at night is quite a difficult problem. The earliest method employed was to place a battery of searchlights about the field, directing the rays upon the ground But this method was found to be both expensive and inefficient.

After much experimentation a single floodlight of 500,000,000 candlepower has been developed by the B B T Corporation which answers the purpose far better. The light carries a large ground lens, built up of twenty-one dioptric elements, and throws the light in an arc of 180 degrees, covering an area of approximately half a square mile. The intensity is such, however, that a book or a newspaper may be read at a consider

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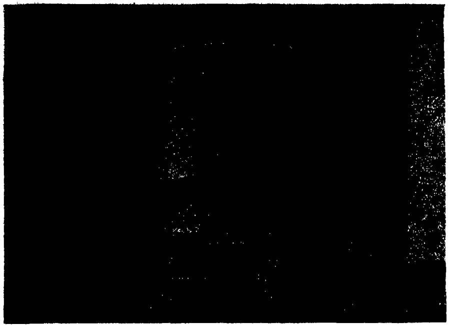


The landing light on its movable chassis

able distance from the light The direction of the rays is also very easily controllable, and the beam may be made to reflect not more than four feet off the ground, so that there is no danger of blinding the pilot

The first of our photographs shows the landing light on its movable chassis The second photograph shows it at work; the pilot's eye is clearly seen to be above the powerful beams, while he can evidently see the ground with perfect clearness

The Future of Flying

LONDON *Airways* prints an interview with Professor A. M. Low entitled, "The Future of Flying" Professor Low is an inventor of distinction, a man of vivid yet scientific imagination. We read of his glimpses into the future with interest and respect.

Present-day air travel with the passenger locked up in a close and cramped cabin is far from comfortable. The worst discomfort of all and the chief cause of airsickness is the noise of the engine. Professor Low is of the definite opinion that aero engines of the future will be noiseless, with carefully designed silencers and with the large valve clearances of today cut down considerably, to lessen the chatter of the valves.

Nor have we reached the limit of speed in air travel; certainly not on the score of human endurance. "If you put a man into a closed box and send him through the air in a straight line at 400 miles per hour, how is he to know at what speed he is traveling or to feel any ill effects?"

Professor Low predicts the displacement of the wooden airplane by all-metal construction, and of the gasoline engine by a far safer engine, one burning a heavy fuel oil. In these views many authorities agree with him. But perhaps some of these authorities will be startled by the statement that "eventually all aircraft may be driven by power, broadcast into the air from wireless stations" Here is a still more extraordinary prediction: "There is no reason why, with metal aircraft they should not be made to land or ascend in an electromagnetic field"

The Professor has very strong views about airdromes. "Airdromes at present are one of the greatest handicaps to the development of flying. Streets will eventually be roofed in to provide landing grounds for aircraft. . . The airport of the future will be a very different thing from the temporary, lonely and muddy thing it is at present A hundred years hence, or less, the air traveler will walk into a comfortable and well appointed waiting room in the center of the city An elevator will take him up to the roof where he will step direct into a roomy and really comfortable airplane cabin There will be no bumping over a hilly airdrome, but the machine, mounted on a turntable, will be shot off into the air by catapults and travel through space at over 300 miles an hour"

These fascinating opinions are encouraging to read. And perhaps what appears startling today, may soon be a commonplace.

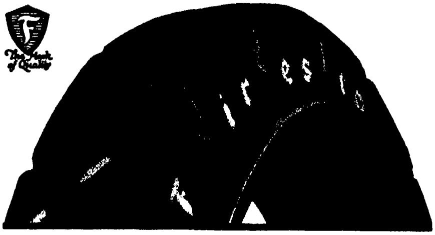
Night Advertising

THE electric signs of Broadway may soon have an aerial competitor Ronald Rohlfs, the well-known pilot who once held the world's altitude record, describes in *Aviation* a new form of night airplane advertising sign which seems promising.

Glass tubes of five-eighths of an inch in diameter, shaped to form any desired letters are attached to the underside of the lower wing of a biplane by special shock absorbers of very light construction The tubes are filled with Neon gas, and, when a current of electricity is passed through them they give off a singularly penetrating red light No reflectors are required; it is only neces

(*Continued on page 213*)

The powerful beams of the light used for landing planes at night makes it possible for the pilot to see the ground with perfect clearness



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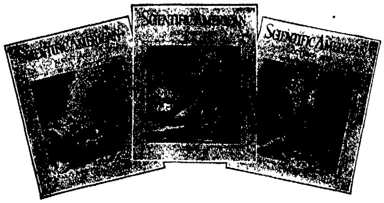
PAUL von BOECKMANN

Author of "Nerve Force" and various other books on Health, Psychology Breathing Hygiene and kindred subjects many of which have been translated into foreign languages



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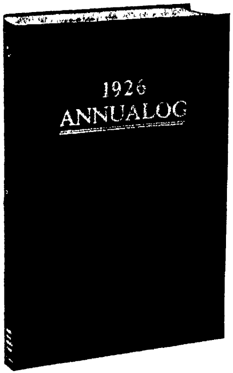

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Kadel & Herbert

A "take off" by a parachute jumper, 1,500 feet above Pearl Harbor, Hawaii. The jumper is Lieut. J. R. Tate, U. S. N. The camera snapped him just as he was dragged from the speeding plane into space. His parachute has just started to open up

sary to paint the under surface of the lower wing a dark non reflecting color

Owing to the tubular character of the letters their air resistance is small and the unbroken line of light in each tube adds greatly to its legibility The current is obtained from an electrically driven generator, with a step-up transformer to give the high voltage required The whole outfit with several letters, weighs only 100 pounds and several night demonstrations of this new form of advertising have been highly successful

Thermostatic Airship Control

IF expensive Helium gas is to be used in airships, valving losses must be reduced to a minimum Two Berlin chemists, Drs Kurt Peters and Peter Schlumgohm, have attacked this problem from a new angle, by providing for the control of the gas temperature At the beginning of a voyage the gas is heated electrically so that its bouyancy is increased and the carrying capacity of the airship is thereby improved As the fuel is burned up and the load becomes lighter, the temperature of the gas is allowed to decrease and equilibrium is thus maintained This is perhaps a simpler method than the process of exhaust-gas recovery practiced on the *Shenandoah* and the *Los Angeles*

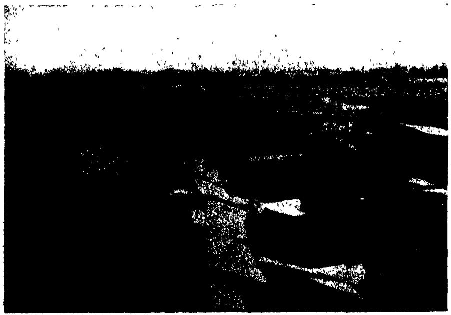
Thermal control, skilfully employed might also be used to prevent valving of gas under such circumstances as heating of the gas by the sun's rays

The Berlin chemists have not carried their work beyond the laboratory stage, but there seems no reason why their method should not be extended to use on actual airships

Landing in a Fog

FLYING in a fog is bad enough, but radio direction finders can help the pilot effectively on his journey. But how can he land? This is how the British propose to tackle the problem this winter, according to General Brancker

"At Croydon, during the coming winter, I hope that we shall be able to try out at full scale a complete system of landing in a fog The aircraft will be led up to the airdrome through its wing coils It will discover the right line of approach and alighting by balancing the signals from a leader cable (the leader cable being a cable laid along the ground and carrying a current from which aircraft can be guided by their pilots so as to fly directly over the cable), and a line of Neon lights (glass tubes filled with Neon gas which under high voltage give a very penetrating red light) laid along the leader cable on the ground will show the pilot where to flatten out as he glides down in accordance with the leader cable indications It behooves every expert in sound, light and electricity to turn his mind to this difficult and interesting problem"



Transatlantic

The Kowno Airdrome (Russia) one of the relay ports of the German-Russian-Air-Company. The number of passengers using airplanes for trips to the eastern countries is augmenting every day, the journey by plane being much shorter and much more comfortable than by train

Geared to the Pace that Pays

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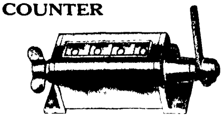

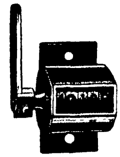

The Set-Back Revolution Counter above records the output of the larger machines where the revolutions of a shaft record operations or output Counts one for each revolution, and sets back to zero from any figure by turning knob once round Supplied with from four to ten figure-wheels, as required Price, with four figures, as illustrated, $10 00 (subject to discount)

The Small Revolution Counter at left records the output of smaller machines where a shaft revolution indicates an operation Though small, this counter is very durable, its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines Will subtract if run backward Price, $2 00

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Amateur Telescope Making

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Better Protection Abroad

"THERE was held at The Hague from October 8 to November 6, 1925, a conference to consider the revision of the Convention of the Union for the Protection of Industrial Property," reports Patent Commissioner Robertson, who attended the conference as Chairman of the American Delegation.

"The convention, which relates principally to patents and trade-marks and provides for the granting of certain reciprocal rights, was adopted at Paris in 1883 and revised at Brussels in 1900 and at Washington in 1911 Its fundamental principle is the agreement of each country to treat the citizens of all the other countries of the Union exactly as it treats its own citizens in these matters The Union is now composed of 32 countries, and the revised convention adopted at The Hague was signed by delegates from all these countries.

"The particular changes made relate to the working of patents, the granting of a period of years for the payment of taxes, the prevention of piracy of trade-marks and the repression of unfair competition"

An agreement was reached that the period of three years which must be allowed before any penalty can be imposed for not working is to be reckoned from the date of the grant of the patent instead of the filing of the application. This is described as a very material advantage to Americans.

Another new development is the provision for the cancellation of fraudulently registered trade-marks. This is believed to furnish an effective remedy against piracy of well-known marks.

"While the conference did not go as far in the matter of working patents and the taxes thereon as the United States delegates desired and proposed," Commissioner Robertson concludes, "it afforded very material relief from the former onerous conditions, and the adoption of the present conference is a long step forward in the direction of doing away entirely with requirements of working in order to maintain a patent in force."

Historians Take Notice

DR IRVING LANGMUIR, Assistant Director of the General Electric Research Laboratory, is now definitely accorded a place among the world's great inventors He has been awarded a patent for the modern vacuum tube used extensively in radio, X ray and similar work Thus award ends a twelve-year battle for the patent rights.

Dr. Langmuir made his invention in 1912 Since then it has been the center of controversy The legal battle was suspended during the World War, because of the necessity of war work being done by the litigants, but was resumed soon after the Armistice

The tube is characterized by its hard, constant vacuum and its general reliability, permitting operation with more than 50,000 volts as well as smaller currents, such as are used in home radio receiving sets The invention is described as making possible the enormous development of practical radio within the last ten years It is estimated that there are more than 10,000,000 tubes embodying the invention now in operation in the United States.

Joint Inventors

FOR a long time it has been a well-established principle of patent law that where two men, who believe themselves joint inventors file a patent application jointly, later learn that only one of them actually is the inventor they may amend their application for a patent so that the patent issues only to the one who is the inventor.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion, minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

Mooring Device for Lighter-Than-Air Craft —By means of which the ship may be safely moored by the crew, without employing operators on the ground. Patent 1551655 O. Geisler, 6947 Peoria St, Chicago, Ill

Safeguarding Against Aerial Attacks. — By releasing at intervals, from high speed aircraft, a series of parachutes, each supporting by a long light cable a contact bomb, to obstruct the probable line of attack Patent 1558713 J A Steinmetz, c/o Jenney-Steinmetz Co, Philadelphia, Pa

Airplane Adjusting Device. — Wherein means are employed within the fuselage and within easy reach of the operator whereby the wings may be simultaneously shifted. Patent 1560341 H H Flath, R. D. No. 3, Erie, Pa

Pertaining to Apparel

Undergarment. — Composed mainly of visca or artificial silk, and having the edges bound with real silk to prevent damage when the fabric is wet Patent 1554800 A Leopold, c/o Carl Gutman & Co, 334 Fourth Ave, New York, N Y.

Underhose.—The toe, sole and heel portions being less thickness than the rest of the hose, so that they may be comfortably worn under silk outer hose Patent 1555752 O. Osborne, Jr., 1845 E Willard St., Philadelphia, Pa

Collar Supporter.—For turnover collars of the semi-soft type which functions to hold the outer portions properly spaced from the neckband Patent 1550517. S. L Gedney, 33 Clinton Ave, Maplewood, N J

Union Suit —Wherein the crotch seam and belt effect are entirely eliminated, the entire construction being for comfort and freedom Patent 1550845. J. P Brown, 91½ Grant St., Atlanta, Ga.

Necktie Holder —Whereby a previously knotted necktie can be readily attached to a collar button and drawn up under the collar folds Patent 1559823 A W Wilson, 180 Duboce Ave, San Francisco, Calif

Chemical Processes

Test for Petroleum —For determining the flashing and burning points of petroleum products by a thermometer test Patent 1554093 C Ettele, c/o Standard Oil Co. of N Y, Sannomiya P O Box 357, Kobe, Japan

Process of Making Oxygen, Containing Soap Powder —Which consists in mixing potassium permanganate with paste like soap, and mixing the same with an oxidizing agent Patent 1555588. R. Korselt, Zittau, Saxony, Germany

Method of Purifying Hydrocarbons — Resulting from the distillation of crude oil containing wax, by causing crystallization and then mechanically separating the oil from the wax crystals Patent 1562425 A. Greenspan, c/o Dr O Wasser, Lwow, Kosciuszki 6, Poland

Electrical Devices

Battery —Constructed to carry a substitute for the usual hard rubber insulator plates, which will take up no additional space Patent 1557952. W. L Whidden and L McCartney, Morgan Hill, Calif.

Thermostatic Switch —In which a flexible device supports a circuit breaker caused to open or close at an expansion or contraction of its support. Patent 1561425. H R. Fernandez, 14 Villegas St., Havana, Cuba.

Clock Mechanism.—In which the movement is actuated by electric impulses consisting of a minimum number of parts. Patent 1561786. H. M. Huemann, 411 6th St., Wallace, Idaho.

Folding-Loop Antenna.—Which may be folded up and quickly extended, the wires being held normally taut when extended. Patent 1559193. M. W. Stavrum, R L. Olson, and W. H. Berry, c/o Radio Appliance Laboratory, 4884 N. Clark St., Chicago, Ill.

Of Interest to Farmers

Checking Implement —For the throwing up of checks or levees in preparing agricultural land for irrigation Patent 1557035 W Dost, Route 3, Box 41, Yuba City, Calif

Apparatus for Grinding Fodder, Straw or Similar Rough Food for Stock.—Which may be mounted upon the chassis of a motor vehicle and driven by the propelling power. Patent 1558394. J. N. Rice, 613½ So. 7th St, St. Joseph, Mo.

Fruit-Gathering Apparatus. — Which will automatically pick up fruit such as prunes, or other spheroidal bodies, and deposit the same in boxes without injury. Patent 1558924. A. N. Riggs, 297 Reed St., San Jose, Calif.

Of General Interest

Drawer Attachment for Sinks. — Whereby, with relatively simple means, a plurality of drawers for holding kitchen ware may be attached to a sink. Patent 1558274. C. A Peterson, 7716 Calumet Ave., Chicago, Ill.

Daylight Developing of Photographic Plates and Films.—Whereby the developing process can be readily carried out in the field without the use of a stationary dark room. Patent 1563228 C. D Rodriguez, Leon, Nicaragua, Central America.

Combined Spacing and Tie Bar for Concrete Forms.—Particularly adapted for use in connection with the usual wooden forms employed when building concrete foundations, walls and the like Patent 1556313. J H. Dodd, P. O. Box 703, San Francisco, Calif.

Card-Index File —In which the cards are arranged radially above a drum in a manner to be readily accessible. Patent 1558376. L. R. Lewis and J. J Colvin, Hudson Falls, N. Y.

Gutter Mount.—Which permits the gutter to be removably connected to its support, and the support located under the tiles or shingles forming the roof. Patent 1558385. C. Meunier, Box 145, Great Neck, N Y.

Grass Seed Container.—For use in the first instance, as a sales package, and secondly as a means for sowing the seed. Patent 1558396. R. L. Roehrs, Roehrs Nursery, Rutherford, N. J.

Adjustable Finger Ring.—In which the head and shank are constructed as separate elements, adjustable to fit fingers of various sizes. Patent 1558418. F. B. Wendel, c/o Hercules Novelty Mfg. Co., 126 South St., Newark, N. J.

Process for Separating Calcined Colemanite from Clay and Other Impurities. —Consisting in discharging the material to be treated peripherally, by centrifugal force to cause a rain of particles over a circular zone. Patent 1556110. H. D. Hillmers, c/o West End Chemical Co., Oakland, Calif.

Patent Commissioner Robertson, however, in his recent decision in Ex-Parte Benes gives definite expression of the fact that the contrary does not hold true. Benes sought *to change a sole patent application to a* joint application, saying that his friend, Warren J. Fretz, was a joint inventor.

> "It is true," says the Commissioner, "that the subject matter of the application remains the same, but it adds an additional party who did not sign the specification or join in the oath as originally filed. To accept the amendment, would, in effect, be giving a filing date and a serial number to an incomplete application, as the proposed joint application was not complete as a joint application at the time this application was given a filing date"

This rule might well have the effect of preventing a patent from ever being granted in the case of an inventor who files a sole application and later discovers that the invention is a joint one

Victory for Small Grocers

THE independent grocers have won a skirmish in their fight with the chain store organizations. It is over the prices they pay for Uneeda Biscuit, Nabisco, Zu Zu and three hundred other products of the National Biscuit Company and Tak-hom-a biscuit, Parfetto, Yum Yum and other products of the Loose Wiles Company.

In many localities, the Federal Trade Commission finds, there is such a demand for these advertised cakes and crackers, that it is impossible for a grocer to conduct his business without them. The chain stores, however, are able to undersell him because the big baking companies charge them less than they charge the independent man, despite the fact that each chain store, or unit, is solicited separately by a salesman and its requirements supplied just as though it were an independent store.

The independents, organized into grocery associations, demanded the same discounts for quantity purchases as the chain stores were getting. The National and the Loose-Wiles companies refused, except on the Pacific Coast, where other cracker manufacturers are outselling the National and the Loose-Wiles.

After a thorough hearing of the facts the Federal Trade Commission orders the baking companies to desist "from discriminating in price between purchasers operating separate units or retail grocery stores of chain systems and purchasers operating independent retail grocery stores of similar kind and character purchasing similar quantities of respondent's products."

Orange Beverage, 5c a Glass

YOU might visit Washington and fail to see the White House, the Washington Monument or the Patent Office, but to fail to see an "orange beverage" store would be an impossibility The pioneer in this business is Carroll Dikeman who has a chain of retail stores throughout the city. Each has a white painted front with glass folding doors and on either side of the entrance the legend "Dikeman's Delicious Orange Beverage 5c" in gilt letters, surmounted by a representation of a cluster of oranges and foliage. The entire sign is convex and surrounded by a blue border.

Some time ago Kissel and Kokalis, Washington lunchroom proprietors, started in the orange drink business, placing at the door signs so closely resembling Dikeman's that even President Coolidge himself might be misled.

The Federal Trade Commission, however, has come to the rescue. It has ordered the lunchroom partners to stop making their place resemble Dikeman's.

Aperture Sight.—Constructed to obviate eye-strain when using cup peep sights, the device may be readily fitted to existing types of rifles. Patent 1558967. R. K. Johnston, 40 Dowling St., Dunedin, New Zealand.

Staging Bracket.—Which eliminates the necessity of employing expensive scaffolding for effecting repairs to a gutter or edge of a roof. Patent 1558425. O Yetter, 27 Marcella St., Boston, 19, Mass.

Lawn Sprinkler.—Whereby the sprinkler will act automatically and periodically to vary the position of the spray nozzles. Patent 1558355. C. W. Hart, 3231 Post St., Los Angeles, Calif.

Rack for Collars and Neckties.—Whereby such articles may be better displayed in stores, or more selectively assembled in the home. Patent 1557989. A. Dombrowsky, Box 57, Balboa, Canal Zone.

Check-book Blotter.—Adapted to be readily secured to the holder of a check book and to overlie the uppermost check. Patent 1558354. O. H Halverson, 701 Marshall St., Manitowoc, Wis.

Binder for Cards and the Like.—Wherein the titles, names or the like appearing in the marginal portions are visible as an index. Patent 1556908. C. A. Briggs, Chino, Calif.

Shelf Cabinet.—Which will do away with waste space and provide for extending shelves for the storage of maps or plans. Patent 1556711. Z. P. Pietrzycki, Klamath Falls, Ore.

Boat.—Of the paddle wheel type, wherein the paddles dip into and out of the water in the manner of the oars of a row boat. Patent 1557990. F. D. Doty, Box 1608, New Orleans, La.

Holding Device for Vibrators.—In which a razor with a straight edge may be clamped in either right or left hand position. Patent 1558327 G Adelmo, c/o J. Mignone, Spring Valley, Ill.

Toothbrush.—Having a handle so formed that a roll or wad of cotton may be carried therein, for polishing the teeth and gums. Patent 1559519. T. A. Buckley, 80 Carlyle Ave., Yonkers, N. Y.

Eyeglasses or Spectacles.—With means for properly positioning the glasses and holding them always at the same angle to the eyes. Patent 1558744 E B. Miner, 65 E. Holland St., Portland, Ore.

Paperhangers' Trimming Gauge.—By means of which the operator may lay a straight edge at an exact pre-determined distance from the edge of the paper. Patent 1558678. R. F. Koenig, 106 E Washington St., Jackson, Mich.

Sanitary Can and Seal.—In which coacting folding portions, not only act as a seam structure but as means for containing sealing material. Patent 1559096 W. M. Hall, c/o Flagg, Hall & Adams, 183 Main St., Brockton, Mass.

Attachment for Cribs, Perambulators, and the Like.—Which will hold a mosquito canopy, or the like in proper position, and is easily removable when not desired. Patent 1559352 V. P. Nelson, 264 Lexington Ave., New York, N. Y.

Candle Ring.—An efficient attachment for a candle whereby the same may be firmly held in any type of socket. Patent 1559304. E. L. Bearse, Centerville, Mass.

Washing Brush.—Wherein the water is applied simultaneously with the application of the bristles to the surface to be washed. Patent 1559441. W. Kundel, P. O. Box 226, Hoboken, N. J.

Hair-trimming Guide.—Particularly designed as a means for facilitating the trimming of bobbed hair. Patent 1559363. Jean Parsiale, 110-10 Jamaica Ave., Richmond Hill, N. Y.

Chart Holder and Finder.—For facilitating the tabulation of column indicia, whereby reading and comparisons may be rapidly made. Patent 1559459. J. Rogers, 32 North Ave., New Rochelle, N. Y.

Sound Box and Tone Arm.—Having a mounting whereby the arm is maintained in a steady position, and more effectively supports the free end. Patent 1559514. J. Zitserman, 449 Stone Ave., Brooklyn, N. Y.

Smoke-printing Device.—Wherein smoke may be directed through a perforated member for producing a picture, or other desired configuration. Patent 1559346. P. J. Maloney, 2211 82d St., Brooklyn, N. Y.

Pipe Cleaner.—An assemblage adapted for cleaning the stem of a smoking pipe or loosening the tobacco. Patent 1558652. E. A. Thornton, Valentine, Neb.

Tree Stand.—For holding Christmas trees and the like, which may be quickly mounted, and easily stored in a minimum space between periods of use. Patent 1559563 G. Edmister, 210 South 11th St, Lincoln, Neb.

Casement Window.—Especially of the inswinging type, having a special weather strip for preventing wind or rain from passing between the sill and sash. Patent 1558954 A. E. Walker, 2372 Sandy Blvd., Portland, Oregon.

Holder.—For carrying articles relating to the use of a telephone, including the telephone book, a writing pad, pencil and a calendar. Patent 1560493. P. Steinberg, 2221 Jerome St., Toledo, Ohio

Device for Cleaning Floor Drains.—Which loosens accumulations of foreign substances so that they may be forced down through the goose-neck trap. Patent 1559,900. E. V. McCarthy, c/o Electric Shoe Shop, 1151 W. Madison St., Chicago, Ill.

Ledger Stand.—Supported on casters, adjustable as to height, and by the use of which the lifting of the ledger is entirely obviated. Patent 1559844. C. E. Brooks, c/o Commercial Savings Bank, Mason City, Iowa.

Indicator.—Particularly adapted for use at gasoline stations for displaying the price of gasoline and calculating amounts representing various quantities. Patent 1560336. J. F. Dodd, 67 Lincoln Ave., Delaware, Ohio

Method for Automatic and Rapid Production of Crystallized or Preserved Fruits.—Treating large quantities, and obtaining in three to four days, without handling, a crystallized marketable product Patent 1560396 P. Navarre, 56 Avenue de Chatillon, Paris, France

Razor-Stropping Device.—Whereby both sides of each cutting edge of a safety razor blade will be sharpened. Patent 1559897 F. A. Leigh, 827 Newport Ave., Chicago, Ill

Check Protector.—Which is small, may be readily transported in the pocket, having serrated impression members for covering the numerical amount of a check. Patent 1561,423. J Evans, c/o U. S Naval Fuel Station, Melville Station, Newport County, R. I

Cordage Structure.—Having a cover for the strands constructed to give greater strength than is the case in rope of ordinary construction Patent 1561357. F. Riesenberg, Tuckahoe, N. Y.

Low-Water Alarm for Boilers.—Adapted to be attached to a steam boiler of conventional construction, being actuated when the water falls to a definite level. Patent 1561135. W MacA. Barbour, 709 Henry St. S. W., Roanoke, Va.

Box Closure.—For shoe blacking and similar pastes, which may be readily opened without the use of tools. Patent 1561330 A. H Keller, P O. Box 586, Pleasantville, N. J.

Stand.—Of pedestaled receptacle design, for use as a smoking stand, having rotary movement, a match box holder attached, and means for discharging refuse. Patent 1561-339. E A Muraffi, c/o Electrolite Products Co., 1148 De Kalb Ave., Brooklyn, N. Y

Container.—Which will support a tube of tooth paste, shaving cream or the like, in vertical position thus preventing exudation Patent 1561382. G. Walters, c/o Mount Royal College, Calgary, Alberta, Canada.

Manufacture of Rolled Metal Disks
Whereby the cost of production is greatly reduced and waste material is practically eliminated Patent 1561346 F. Milliken, 44 W. 44th St, New York, N Y

Check Valve.—With a minimum interruption of flow, the structure being such that the valve disk may be ground onto its seat at any time. Patent 1561395 E. T. Adams, c/o The Fairbanks Co., 416 Broome St., New York, N. Y.

Grater.—Of the cylindrical type, having a removable member with a grating surface which permits of the device being cleansed without inconvenience Patent 1561401 M Bembina, c/o D. G. Vernaci, 44 W. 44th St, New York, N. Y.

Suspensory.—So constructed that the sack may be readily renewed, and yet is properly supported when in use. Patent 1560753. W J. Young, 564 N. W. 30th St., Miami, Fla.

Device for Cleaning Smoking Pipes.—Which will permit a powerful blast of compressed air, such as that obtained at automobile service stations, to be applied to the pipe. Patent 1560903 F. Eiche, 2000 S. 23rd St., Lincoln, Neb

Flowerpot.—Which has novel means for draining any excess water from the pot, thus preventing the plant roots from rotting Patent 1561824 H M Boehm, c/o Boehm Decorating Co, 252 First Ave N, Minneapolis, Minn.

Tubular Holder.—In which an explosive charge may be lowered in the bore of a well or like place Patent 1562123 E L Pitts, c/o C C Fisher, Okmulgee, Okla.

Flytrap.—Of extremely simple construction, which can be folded flat for storage or transportation Patent 1561661 F D Pepper, 413 Edwards Bldg, Jackson, Miss

Stamp Holding Device.—Comprising a cup-shaped casing having a slotted peripheral flange and a plurality of spring fingers for supporting rubber stamps Patent 1562369 A. W. Schmidt, c/o Consolidated Stamp Mfg Co., 87 Maiden Lane, New York, N Y

Direct Cooling of Goods.—By refrigerating or freezing of goods through direct treatment with a cooled solution of inorganic salts, or both inorganic and organic matters. Patent 1562360 A J A Ottesen, 14 Dosseringen, Copenhagen, Denmark.

Wall Construction.—Including an enameled sheet metal construction forming a substitute for the wainscotting, so that the surface will be waterproof Patent 1562233 E A. Hayer, 502 W. 122nd St, New York, N. Y.

Artificial Stone and Process of Making.—Which characterizes certain striated or veined surfaces, and simulates the age worn appearance, of the natural Roman travertin Patent 1560450. R. M. Wesely, Los Angeles, Calif

Clothes Drier.—In the form of a standard with a plurality of radially extending arms, removable when not in use, and securely locked in use. Patent 1563137 G Amsler, 201 W. Duncannon Ave, Philadelphia, Pa.

Pipe Holder.—Which is portable, and will hold a smoker's pipe in position to prevent the ashes from falling onto a desk or the like Patent 1563210 J H McIntire, 276 Jefferson Ave., Brooklyn, N Y

Attachment for Pencils.—Adapted to cooperate with a pencil of ordinary construction, without extensive changes, to hold a pen at one end of the pencil. Patent 1563,277. C. M Haddox, 6 California Apartments, California Ave, Charleston, W Va.

Combined Cigarette Container and Ash Tray.—Associated with a package of cigarettes of ordinary type, and when not in use has all the compact features of the regular package. Patent 1562497. W. R. Derry, c/o L J. Fluker, 741 Green St., Union Point, Pa

Strainer.—Which will function to collect sediment in the bottom of the strainer, out of the path of movement of the milk Patent 1562492 A. Brown, Plymouth, Wis

Book Cover.—An auxiliary binding, formed in a single piece which can be conveniently applied to the regular binding of a book of any one of a plurality of sizes within considerable range The inventor has been granted two patents, 1562504 and 1562505. E. W Jackson, c/o E L Steck & Co., Austin, Texas

Hardware and Tools

Quick Release Safety Hook.—Comprising two complementary hook-shaped body members and two clamping springs, in addition to a swivel link Patent 1561337 T F Madigan, c/o Collison & Co, 483 Collins St., Melbourne, Australia

Sand Riddle.—Or screen, of woven wire, having regularly spaced upset portions, and flat portions between the upset portions Patent 1563047 M J Somers, 13 E Columbia St, Springfield, Ohio.

Machines and Mechanical Devices

Universal Joint.—Which is particularly adapted for use in the transmission of power where exceedingly heavy strain is to be applied. Patent 1556840 W. H Kadesch, 1100 Main St., Cedar Falls, Iowa

Pressing Machine.—Especially constructed to obviate the wrinkling and constriction of the lower ends of tapering trousers legs. Patent 1558946 J Tedford, N E. cor State St. and Jackson Blvd, Chicago, Ill.

Check Protector.—Which will automatically move a type into printing relation for printing the amount on a check, and mutilate the check to prevent unauthorized changes Patent 1558869 C A Gulling and E W Cheney, 139 No Va St, Hoyt, Norcross, Cheney & Hoyt, Reno, Nevada.

Mixing Apparatus.—Particularly adapted for mixing the proper proportion of lime with sugar juices Patent 1558669 O. Prieto y Cruz c/o Central Boca Chica, Inc, Apartado 169, Ponce, Porto Rico

One Man Boat Launching Apparatus for Ships.—By which one man can by himself launch a life boat ready to be filled with passengers and crew Patent 1559534. C B Osbon, 107 College Ave, West Somerville, Mass

Beam Rest.—For use in removing beams from warping machines, the rest being constructed to support the filled beam Patent 1559434 W Imbt, c/o Russell Imbt, Box 115, E Stroudsburg, Pa

Machine for Printing Photographs.—Adapted for quantity production, the device being constructed to hold a number of plates, and sufficient paper for successive printing in series Patent 1559438 A M Josepho, 16 W. 46th St, New York, N Y

Motor Drive for Wringers.—Which can be readily secured to a standard type of wringer, and transform the same from a hand-operated to a mechanically driven device. Patent 1560387 H C Law, Factory Lane, Hastings on Hudson, N Y

Oil Cup.—Having an automatic feed controlled by the temperature of the machine bearings, and feeding the necessary quantity from time to time Patent 1560338 L C Dutro, 2020 Cerritos Ave, Long Beach, Calif

Measuring Apparatus for Boards.—A timber-measuring device, which automatically determines both the dimensions and number of boards measured, and the sum of the values. Patent 1560392 H Mager, c/o Urbantschitsch, 1 Tuchlauben 21, Vienna, Austria.

Machinery Alarm.—Adapted for use in connection with the clearance space of a reciprocating motor to indicate a reduction of the space Patent 1557957 H Amrhein, 335 W. 4th St, Oxnard, Calif

Hand Propelled Boat.—The propulsion of which is effected by means of levers geared with the propeller at the rear of the hull Patent 1559826 G F. Winter, c/o The Lynch Co., Honolulu, Territory of Hawaii

Saffty Valve.—Which may be readily attached to a gasoline tank to automatically keep the pressure within the tank at a predetermined point Patent 1560457 J E. Wood, c/o A C Anderson, 1911 Washington Blvd, Chicago, Ill

Portable Pneumatic Grease Gun.—By means of which the amount of grease forced into the grease passage may be accurately determined Patent 1559894 C B Lansing, Colorado Springs, Colo.

Key.—For attaching pulleys and the like to shafts, having gripping members formed on the working face for engaging the shaft. Patent 1560399 C F Preston, Sr, Box 666, Mamaroneck, N Y

Pattern Printing Machine.—In which a strip of fabric, such as a bolt of cloth, may be printed with a plurality of patterns of the same nature Patent 1560710 H H Meyer, c/o M Katz, P O Box 55, Station "A," 113 Greene St, New York, N Y

Expanding Plunger for Oil Wells.—To insure the tight fitting of the plunger in the working barrel and unfailingly producing suction for operating the pump Patent 1561407 C Card c/o Mrs C Card, Box 27, Breckenridge Texas

Vacuum Cleaner.—Wherein intermittent suction draft is used, instead of a continuous flow, for lifting the dust from the surface being cleaned Patent 1561321 M Goodman, 9 E 41st St, New York, N Y.

Computing Bin.—Particularly adapted for dispensing such commodities as sugar, rice coffee, etc, by means of a measuring cylinder rotatable under the bin Patent 1560821 I S Karraz and D. V Bridwell, Fargo, Ark

Grinding Mill.—Wherein the ground material is forced through a screen and deposited within a suction and discharge conduit. Patent 1560865 J. B Sedberry, c/o The Bossert Corp, Utica, N Y.

Pump.—Especially designed for use with oil wells, so constructed as to provide an effective sand trap and gas anchor. Patent

1561049. J. H S Bonner and M. T. Chamberlin, Box 1191 Wichita Falls, Texas

Excavating Bucket—Capable of use either with a standard excavating machine or a so-called "slack line" cableway Patent 1560895. F. T Crowe, Guernsey Wyo.

Machine for Forming Paper Hat Rings—As used in supporting hats when packed in a box for shipment and for preventing injury Patent 1562368 B Schiffenhaus, c/o M. Morris, 200 Broadway, New York, N. Y.

Machine for Turning Shoes and the Like—For automatically reversing a shoe or similar article, from wrong-side out to right side-out, or vice versa Patent 1562282 D Baum, 226 Newell St, Brooklyn, N Y

Walking Beam—Having an auxiliary walking beam which rides upon the main beam to increase the stroke of the pump and thereby the output. Patent 1561723 J O Keefover, c o H L Johnson, Gilliland Oil Co, Tulsa, Okla

Medical and Surgical Devices

Apparatus for Treatment of the Ear—Pertaining more particularly to a device for treating certain diseases of affections of the ear with gases Patent 1554876 R. McK Nastasia, cor Norwood Ave and Wall St, Long Branch, N J

Eyecup—Adapted to direct the liquid toward the sides of the eye when washing the same Patent 1557620 H Robinson, 825 N. 11th St, Waco, Texas

Dental Device—Comprising a pair of adjustable jaws for determining the space between the gums for the adaptation of false teeth Patent 1560904. J Ellard, Texhoma, Okla.

Leg and Foot Developer—An appliance that will make heel and toe walking more natural, restore defective muscles to their normal functions, and produce blood circulation in affected regions Patent 1562294 J J. Cooper, 56 W. 47th St, New York, N. Y

Transmitting Means for Ultra-Violet Rays—By therapeutic lamps, in which the interposition of a vacuum between the lamp and the patient reduces the heat without affecting the short wave rays Patent 1559,770 R G Paddock, 510 Stockton St, San Francisco, Calif.

Prime Movers and Their Accessories

Mixing Device.—So constructed as to thoroughly break up or screen and gasify the combustible mixture as it leaves the carburetor Patent 1557362 O Harris, 134 Clay St. Hackensack, N J.

Standard-unit Marine Condenser—For reconverting steam into water, in which only one header is necessary, the tubes being rigidly soldered to that one header Patent 1556697 R L Leach, Box 852, New Orleans, La

Spark Plug—Particularly adapted to high speed engines, where a very considerable degree of pressure and high temperatures are reached Patent 1559463 M Sacchi, 38 Corso Valentino, Turin, Italy

Spark Plug—In which the core is rendered transparent and the spark visible from the outside to note whether or not the plug is functioning properly The inventor has been granted two patents of a similar nature Patents 1560510 and 1560511 L Hirsch, 505 E River St, El Paso, Texas

Spark Plug—In which a pair of electrodes are spaced apart, the terminals forming a spark gap in line with a space between two projections Patent 1560512 L Hirsch, 505 E River St, El Paso, Texas.

Spark Plug—Wherein a pair of sparks is provided with an isolated conductor interposed so as to insure a more complete combustion Three patents of a similar nature have been granted to the inventor Patents 1560513, 1560514 and 1560515 L Hirsch, 505 E River St, El Paso, Texas

Railways and Their Accessories

Locomotive Construction Having four cylinders and four drivers, the drivers being coupled to operate as one, accomplishing a gain in power and speed. Patent 1562281 F A Benolken, c/o Rev J H O'Neill, Mount St Charles College, Helena, Montana

Brake—Especially adapted for use with railway cars, the controlling means being operative at all times while the car is in motion Patent 1561794 P. L Peterson, Box 262, Manti, Utah

Automatic Slack Adjuster for Air Brakes—Which is applicable to any existing type of air brake system, for periodically adjusting the brake shoes. Patent 1560080 W S De Camp, 348 E. Maine St., Chillicothe, Ohio.

Method and Device for Braking Railway and Other Vehicles—Which may be propelled by any motive power to better secure the continuous controlling of brakes, more particularly in long trains. Patent 1562325. P Hallot, 15 Rue du Plelo, Paris, France

Pertaining to Recreation

Game—Consisting of a playing board and playing pieces, the pieces being constructed to partake of eccentric and startling movements Patent 1562322 C Gitchel, Kearney, Neb

Toy with Movable Features—In the form of a doll having a head, body and leg portion, and a sound producing device manipulated by vibration Patent 1561829. I E Cohn, 65 4th Ave, New York, N Y

Card Game—Having a plurality of main and honor suits, forming combinations resulting in a predetermined number of cards designating the winner Patent 1562149 H T Cox, 5676 York Blvd, Los Angeles, Calif

Teething Device—A toy which will amuse a child, and at the same time provide a safe healthful and exhilarating exercise Patent 1562700 W L Herring, c/o F E. Riddle, Mayo Bldg, Tulsa, Okla

Pertaining to Vehicles

Sign—More particularly for use upon automobile doors, constructed of flexible material that it may be adapted to the door curvature Patent 1557955 L. H Young, Visalia, Calif

Brake-Adjusting Tool.—Which will engage the brake foot pedal for adjusting the same and varying the amount of depression Patent 1558854 N Falconer, 1342 Hayes St, San Francisco, Calif

Frame for License Plates—Which will minimize the non-aesthetic appearance of the usual license plate, and its mode of mounting Patent 1561420 F. D Elliott, 608 Carrie St, Sault Ste Marie, Mich

Auxiliary Fuel Tank for Automobiles. So constructed that the driver must deliberately connect up the auxiliary, and therefore know that he is almost out of fuel Patent 1561358 C L Saruelle, 1663 W 11th St., Brooklyn, N Y

Puncture-Closing Composition—For closing punctures or blowouts in inflated vehicle tires, the composition consisting of asbestos, slippery elm bark and water Patent 1561332. T E Law, Mesa, Arizona.

Shock Absorber—In which abrasive plates resiliently maintained in frictional engagement with a sliding plate restrains the movement of the sliding plate Patent 1560594. D F McMahon, 5314 W 24th St, Cicero, Ill

Safety Brake Lock and Brake Locking Device for Automobiles and Trucks.—For locking levers of either the emergency or foot brake type or both to prevent movement of the wheels Patent 1560582 F H Kagarise, 617 Pierce Ave, Sharpsville, Pa.

Neutral Device—Especially adapted for Ford cars, which automatically insures the positioning of the speed control in neutral position, by means of a heel operated pedal. Patent 1561340 C F Marston, 1007 Franklin Ave, Brooklyn, N Y

Center Emergency Brake and Control Lever for Motor Vehicles—Which will equalize the pull upon the brake bands, and which may be easily attached to standard types of motor vehicles Patent 1560636 G C Allen 127 Virginia Ave, Joplin, Mo

Automobile Radiator—Provided with a simple arrangement for tightly fitting the ends of the radiator tubes into an end casting to prevent leakage Patent 1561695. C Costelloe and S G Stoll, 915 Calumet Ave., Hammond, Ind

Revolving Name Plate—The plate being revoluble under the force of a moving current of air thereby attracting attention. Patent 1561830 W C Connell, R No 3, Box 70, Yakima, Wash

Locking Ring for Separable Rims.—Which is flat, extends beyond the felloe for holding the rim, and may be easily secured or removed Patent 1560756. T. D. Bryan, Linden, Calif.

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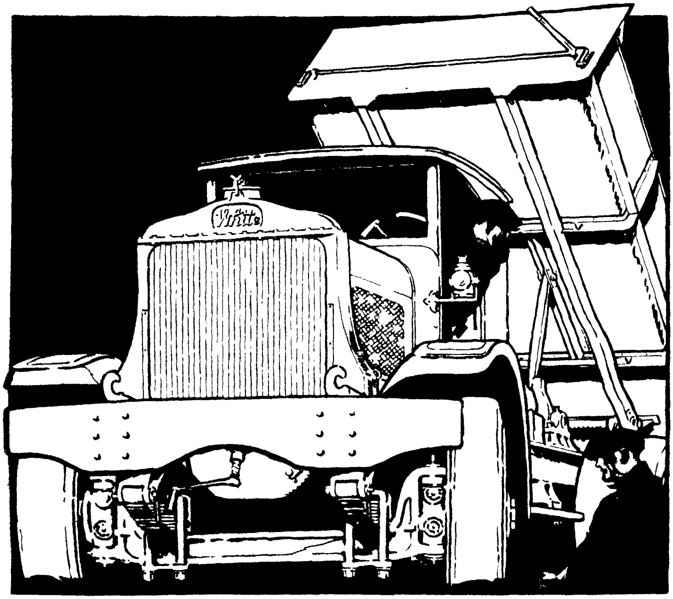
The last word



in Heavy-Duty Dump Trucks

(White Model 52-D)

Anticipating the demands of industry

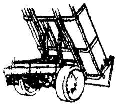
Turn this White loose on any dump truck job. The job is licked! . . . Put a load on it. . . . Stick it in a hole with steep sides or soft bottom. . . . Then slip in that auxiliary gear. Step on it. . . . It just walks out.

Dump? . . . It'll dump any load while you're thinking about it. Sure-acting gears and rigid arms hoist that tapered body to an angle so near straight up that the stickiest load slides out. . . . You can back up to the edge of a soft fill, dump clean and get away without miring. And on the level the load piles up clear of the wheels. . . . Let the body come down safely while you're speeding back for another load.

White engineers are constantly watching all truck operations. Their foresight for the development and improvement of dump truck operation is built into this heavy-duty White.

Let a White salesman show you how this Heavy-Duty White Dump Truck—Model 52-D—will do more work and earn more money for you.

THE WHITE COMPANY, CLEVELAND

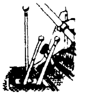


Quick, Clean, Safe Dump

The tapered dump body is hoisted on sturdy arm and link lifts by a safe, speedy and positive gear drive. It lifts to an angle greater than 50 degrees, dumping any load clean. The body is under positive control through rigid connections at all times. It may be held at any angle. It is lowered by the same mechanism that hoists it, but can be lowered with the truck in motion. At normal position and at extreme dumping angle the body is automatically stopped.

The body is mounted so that load weight is properly distributed and the dumping point is so far back that the load dumps cleanly over the edge of a soft fill without danger of miring the truck, or piles clear of the truck on level ground. Double-acting tail gate further facilitates dumping. Low body sides make loading from the ground easy

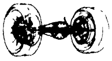
The dumping mechanism sets solidly down in the frame in a dirt-proof and weather-proof housing All the gears run in oil.



Auxiliary Low Gear

An auxiliary transmission gives you maximum power at all times—extreme flexibility of power. In holes, in mire, on hills it enables you to gear down to the hardest pull It works independently of the regular transmission

Power is transmitted in a straight line from starting crank to rear axle when operating under load. This insures maximum power and maximum life of all drive units.



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In every test of heavy-duty service, in every line of heavy truck work, in every part of the world where heavy trucks are used it has proved its superiority to any other type of final drive It has had universal success in the hands of thousands of operators over hundreds of thousands of miles

All of its parts run in oil All of its parts are enclosed It saves time, man power and fuel. It puts more of the engine's power to work

There is in the White Model 52-D the strength, speed, power and safety that heavy-duty dumping operations demand—big, sturdy tubular-type radiator, spring cradled on the frame, wide, heavy, distinctive bumper, tow hooks front and rear easy steering air temperature regulator that saves fuel and adds to engine efficiency in all seasons, heavy-type springs; brakes with drums of a special metal that insures quick and sure stopping and long brake life. Write for complete specifications.

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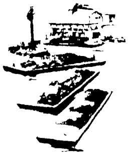

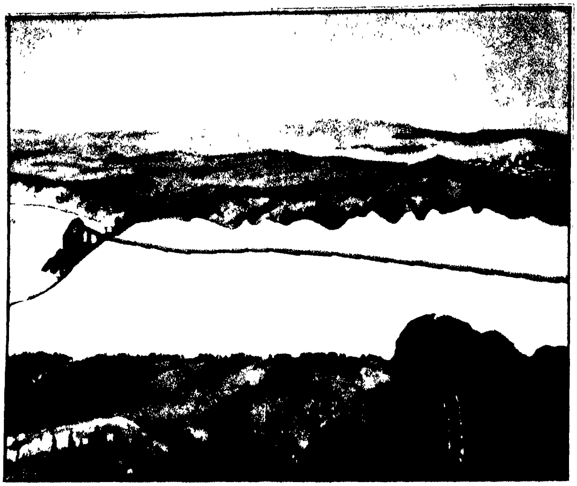

A cross-section of an underground coal conveyor in a Pennsylvania mine—a "river of coal" running at a speed of 500 feet a minute, all uphill. The rotary cylinder dump, longer than a city block, empties a 40-car trainload of coal into the hopper, which has a capacity of 1250 tons.

A wheelbarrow four miles long

The coal mines of the United States require nearly three million electrical horsepower. To meet this colossal demand the General Electric Company produces locomotives and motors for the conveyors that have displaced the poor old mine mule; it designs motors large and small, for huge stripping shovels, loaders, fans, pumps, hoists and undercutting machines—all bear the monogram G E

A giant belt conveyor, whirling through a mountain, and carrying 10,000 tons of coal a day from mine to waterfront—it sets a thrift example for the whole world.

Equipped with G-E motors and automatic control, it almost runs itself. Each motor automatically starts its section as soon as the adjoining belt has attained full speed.

You may never need a wheelbarrow four miles long. The chances are all against it. But somewhere in your factory, or office, or home, there is a task that electricity could do better and cheaper. The General Electric Company makes the equipment to do that task.

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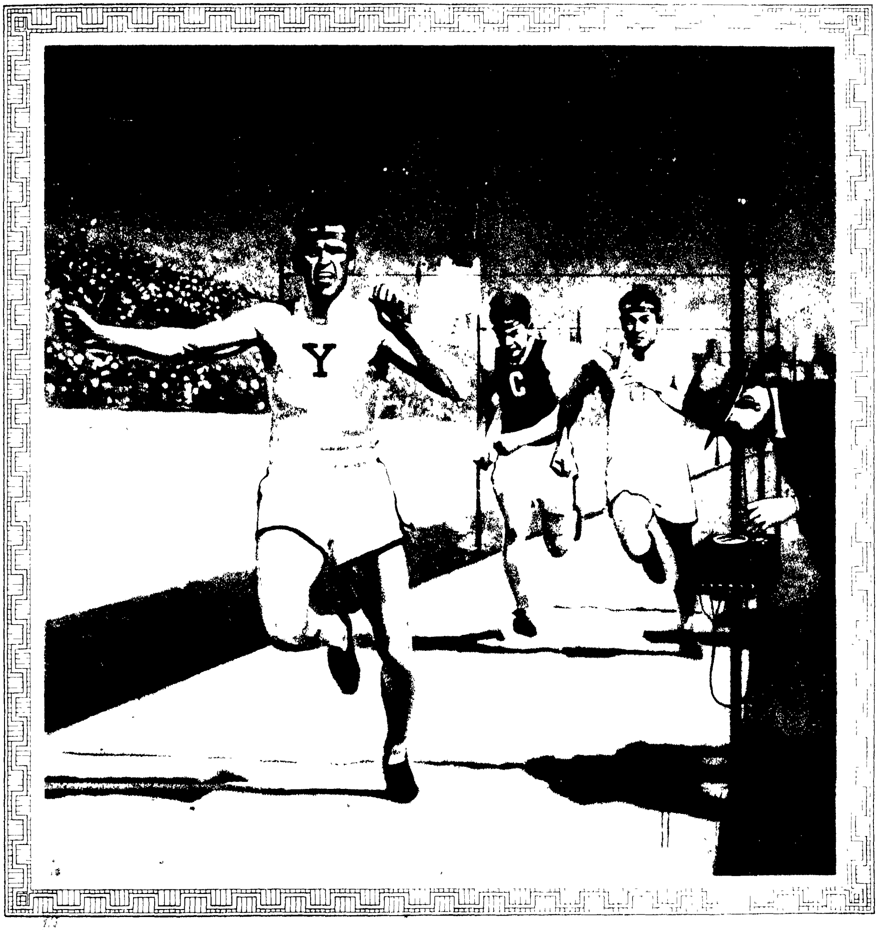

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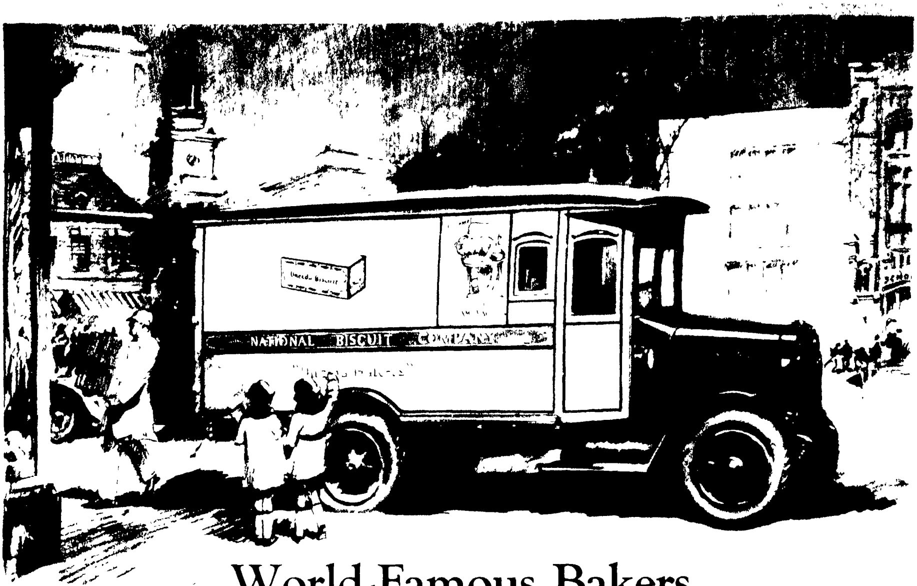

World-Famous Bakers Use International Trucks

THE National Biscuit Company, whose name is celebrated wherever there is an appetite, demands the most exacting and dependable service in the delivery of its wholesome products. From 190 branches all over the country its delightful delicacies, crackers and cookies must be delivered as they come from the ovens fresh, wholesome and appetizing. And you may depend upon it, they do

More than 300 International Trucks are helping to do a remarkable job in the national transportation requirements of the National Biscuit Company.

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International Trucks have been delivering dependable service for twenty years other products of the Harvester Company have been doing it for almost a hundred.

The International line includes a Speed Truck for 2,000 pound loads, Heavy Duty Trucks ranging from 3,000 to 10,000 pounds, maximum capacities and Motor Coaches for all requirements They are sold and serviced through 112 branch houses the largest company owned truck service organization in the world And there are dealers everywhere

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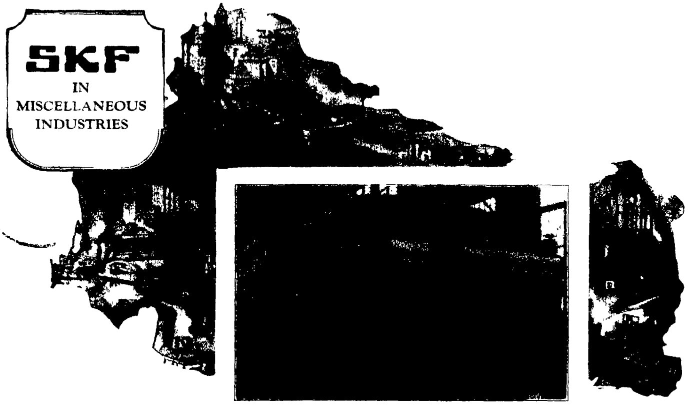
INTERNATIONAL

TRUCKS

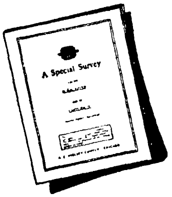
A fleet of trucks recently put into service by contractors to deliver National Biscuit Company products from its Brooklyn, N. Y., Agency



Thirty Skayef Bearings Picked to Maintain Vacuum Seals on This Huge Dryer

VACUUM! It must be maintained at all times on this huge 154-inch vacuum dryer to insure successful operation and —thirty Skayef Self-Aligning Ball and Roller Bearings, because of their precision and freedom from wear, are picked for the job! This machine is used for drying paper, textiles or other fabric under a high vacuum.

Eight Skayef Self-Aligning Roller Bearings, 12 inches in diameter, are used on the seal rolls, and twenty-two Skayef Self-Aligning Ball Bearings on the dryers. The four bearings at each seal end are subject to a load of 50,000 pounds each! Due to the absence of wear in the bearings, the rolls are kept in position and the vacuum seal is unbroken. In addition, Skayefs insure reliability and reduce lubricant, maintenance and power costs.



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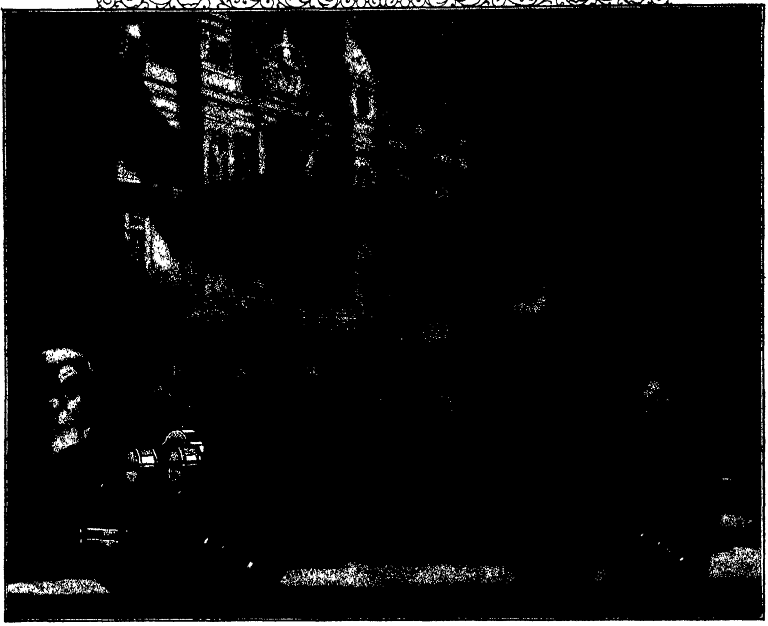

—and now at Monte Carlo

THOSE who have been in Europe during the past few seasons remember the car beauty contests which have been a fad at the famous watering places on the Continent. *Concours d'Elégance-Automobiles* they are called in France.

In these contests, held where the wealth and fashion of all nations gather at play, the most luxurious special bodies, the world's finest motor cars, are judged for beauty and distinction.

Americans will be proud to learn that a standard American motor car has won first prize in such a competition—not once but eleven times!

Packard cars, entered by their private owners, have won first place for grace and beauty at Vichy, at Le Touquet and at Aix-les-Bains in France. At Wiesbaden, Neuenahr, Trier and Baden-Baden in Germany. At Oporto in Portugal. And now at Monte Carlo—that cosmopolitan center of luxury and beauty on the Riviera!

Such international acclaim confirms America's verdict—that the unchanging beauty and distinction of Packard lines have yet to be equaled or surpassed.

PACKARD

Ask the man who owns one

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, APRIL, 1926 EIGHTY-SECOND YEAR

PIONEERING

SOMETIMES a man fails to lead because he runs too far ahead of his fellows. Often this is true of inventors. A splendid example of this was recounted recently at the dinner of the Edison Pioneers in honor of Thomas A. Edison's seventy-ninth birthday.

"Mr. Edison was too early with radio, discovering the spark or wave in 1875," said the Robert A. Carter, who was associated with the wizard of Menlo Park, forty years ago. "In that same year he built a set and published it in the Scientific American, 12 years before Hertz and 22 years before Marconi."

Just as in literature a man spins a thrilling story, only to find that Kipling said the same thing long before him, so the scientist, exploring what he believes to be a virgin wilderness, comes often upon the footprints of Edison, the most prolific inventor the world has yet seen.

HABIT

ON July 15, 1913, the circulation department of the Scientific American sent to a subscriber in the state of Washington, a bill for $3, for a renewal of his subscription. The magazine was a weekly then and cost $3 a year.

Just the other day that bill came back and with it a check for $4.

There is nothing out of the ordinary in the fact that he renewed his subscription. Most subscribers do renew. Nor is it surprising that his renewal did not come back promptly. Once in a while a reader does stray from the path of science. The unusual thing is that the old member of our family of readers waited 13 years before coming back.

The habit of keeping up with science has this danger in it—once it gets you you never are content to live in ignorance again.

NEWS?

THE newspapers recently printed a dispatch from Washington announcing that science "has at last discovered what historians have termed the great sea serpent." The announcement caused Mr. B. A. Broome to write to the New York *Sun* as follows:

"This was discovered and carefully explained forty years ago by Daniel Carter Beard. His account was published in the Scientific American some time in 1885 or 1886 and with it was a large woodcut of a drawing Mr. Beard had made to illustrate how a giant squid would be taken for a sea serpent by anyone unfamiliar with the appearance of a squid at the surface of the water."

All of which goes to show that you really can get the news about science by reading the newspapers—if you only wait long enough.

In This Issue

Uncovering Ancient Greece
Thrilling discoveries of the ancient Greek civilization have recently been made by a group of Americans excavating in Corinth. Commencing on page 221, Dr. T. L. Shear, of Princeton University, tells of their finds.

Your Property Is Being Wasted
J. Bernard Walker this month fires the opening gun in a series of attacks on the squandering of our national resources. Twenty-five billion cubic feet is the drain on your forests every year, he declares, and much of it is needless waste.

An Athlete Is a Living Machine
When an athlete sprints or rows a race, he expends energy at a definite rate which science has found a way to measure. On page 224 a noted physiologist tells you how it is done. More interesting than the sports page.

What Causes Goiter?
Iodine deficiency, says science. Parts of our country lack iodine but there is an easy way to get it. Commencing on page 248, Dr. J. W. Turrentine tells how.

A New Kind of Radio Wave
Experiments prove that the earth's magnetism causes radio waves to turn in the upper air like a twisted ribbon, a discovery which may account for "fading." To remedy this condition, broadcasting stations may use various wavelengths at different hours. See page 234.

MORE THAN 175 PICTURES

Complete table of contents will be found on page 287.

For Next Month

Whence Came Civilization?
Did civilization begin in one place and spread, or did it arise independently in many places? Most anthropologists take the latter view, but a noted authority, Prof. G. Elliot Smith, presents strong evidence for the opposite view.

Getting Rid of Mosquitos
One kind of mosquito causes malaria. One tiny kind of fish eats that kind of mosquito with avidity. Next month a famous naturalist, Dr. David Starr Jordan will tell how it is planned to set this mosquito-hungry fish to work.

How to Correct Auditoriums
Reverberations, echoes and similar faults make hearing difficult in churches, schools and auditoriums all over the country. Next month, Prof. H. H. Sheldon, Professor of Physics at New York University, will begin a series of practical scientific articles by telling how you can correct such auditoriums.

Other articles on Ancient Man; How Can We Produce Scientific Workers?; The New Cosmology; Anti-aircraft Firing Methods; Nature Faking; American Diamond Mines; Contour Measuring; Methods of Wood Preservation; Radio; Astronomy.

MORE THAN 175 PICTURES

¶ **Are you sure you are right? Absolutely—I read the Scientific American.**

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DOCTORS

TOO long has the physician been looked upon as a sort of middleman between the sick person and the undertaker. At last, however, a new conception of the function of the doctor is arising. Dr. Wendell C. Phillips, president of the American Medical Association, voices it

"What will the doctor of the future be?" he asks. "He must have different training. Is treatment the sole function of the doctor of the future? No. He must know preventive medicine. He must keep people well. We are not going to have the diseases we had before."

No small part of the job of the doctor of the future, however, will be to convince his patients that they must not wait for an emergency to call him in. Human nature being what it is, the proportion of the population who will summon a physician, and pay him, when they are feeling well is just about enough to support 27½ doctors.

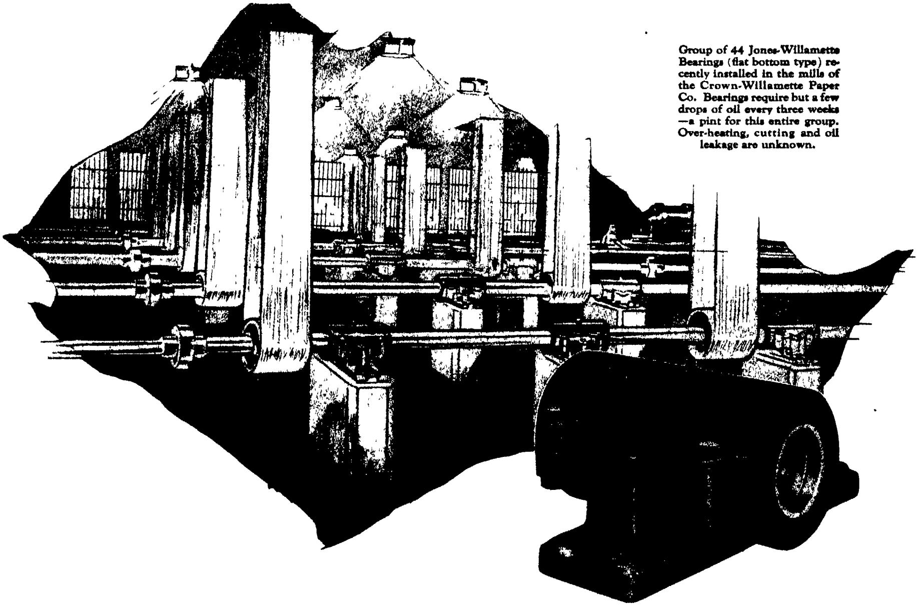
TAXES

IF you are disposed to grumble at having to pay annual taxes to the United States Government, take such comfort as you can from the fact that there are others who are more heavily hit than yourself. Thus we learn from the president of the New York Central Railroad that the tax collectors get more from the American railroads than do the stockholders. Says he, "It takes the earnings of 3,000 miles of our lines to pay the taxes. In other words, one mile out of every four of our 12,000 miles is working for the Government" This is one of the heavy burdens that are being carried by the railroads in their heroic effort to show those dividends of six percent, which are necessary if they are to raise the greatly needed capital for improvements and extensions.

THUGS

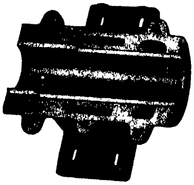
BETWEEN bronze book ends on a gold-embroidered cloth, covering a mahogany table in a lavish New York apartment, stood complete editions of Shakespeare, Boswell's "Life of Johnson," a history of England and a treatise on higher mathematics Here, say the New York police, they found the headquarters of one of the best organized and most dangerous gangs of thugs.

How is it that, obviously steeped in letters and in science, these master criminals were caught by police of a supposedly far lesser degree of culture? Perhaps this is the answer: Such science as the bandits had was for speculative purposes only; what science the police had was used.



Group of 44 Jones-Willamette Bearings (flat bottom type) recently installed in the mills of the Crown-Willamette Paper Co. Bearings require but a few drops of oil every three weeks—a pint for this entire group. Over-heating, cutting and oil leakage are unknown.

This *remarkable bearing* cuts friction in transmission shafting



OIL TIGHT
LESS FRICTION
LASTS LONGER

Action of shaft automatically filters and circulates oil to points of greatest load and friction. Complete lubrication means long life Bearing completely oil sealed—oil cannot escape nor water enter

In the ordinary bearing the points of contact between shaft and bearing, which are the very points subjected to the greatest load and friction—get the *least* oil. In the Jones-Willamette Bearing, however, these points get the *most*, supplying a constant cushion of oil which substantially cuts power losses due to friction.

Power savings are not the only economies which follow Jones-Willamette installations, however. Users report that they have been able to cut down oiling schedules, in many instances, from oiling twice or three times daily, to weekly and even monthly oilings, using in the aggregate as little as one-eighth of the oil previously required. And Jones-Willamette Bearings do not leak oil, which eliminates losses from oil damaged materials in process, as well as removing a constant fire hazard.

We should like to furnish you with one or two Jones-Willamette Bearings for 60 days' trial. Correspondence with our Engineering Staff on your bearing problems is invited.

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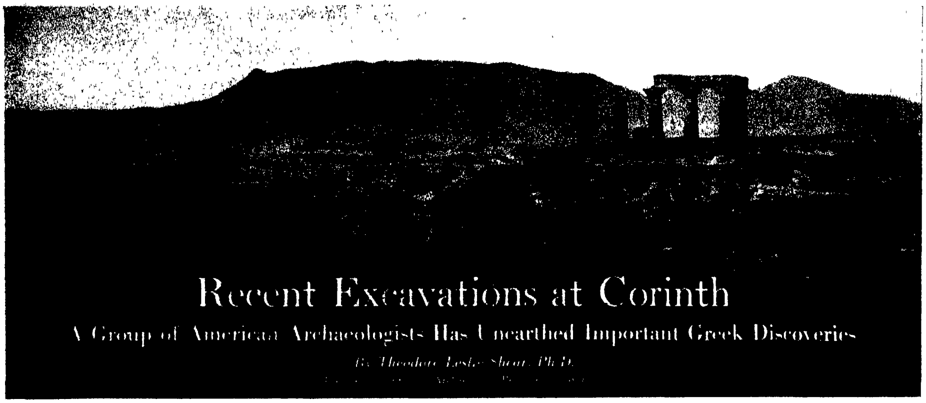


Recent Excavations at Corinth

A Group of American Archaeologists Has Unearthed Important Greek Discoveries

By Theodore Leslie Shear, Ph.D.

BECAUSE of the political, industrial and artistic importance of "wealthy Corinth" in antiquity, the American School of Classical Studies at Athens was attracted to undertake archaeological exploration on this site in 1896. Since then this work has been conducted by the School from time to time with important results.

After a cessation of operations for several years excavations were resumed in the spring of 1925, under the general direction of Dr B. H. Hill, Director of the School. The task of clearing the great theatre was in the hands of the writer, whose wife was the artist of the expedition. Other members of the staff were Richard Stillwell, architect, and two Fellows of the School, Oscar Broneer and Alexander Robinson.

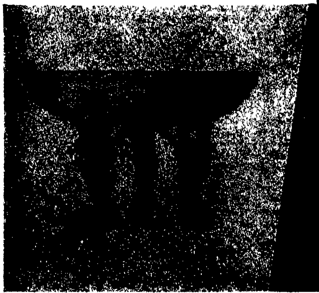
Preparatory work at the theatre was begun early last March and excavation was made above a section of the site included within the west entrance to the orchestra. Small finds, such as bronze coins, were constantly being made, as well as numerous other objects, among which were lamps and fragments of marble and of terra-cotta. All these objects were in the loose earth above the place where the seats of the auditorium should have been, but though the earth was here removed to hard-pan, at a depth of over fifteen feet no part of the structure appeared.

The area of work was then shifted to the southeast, and excavation was resumed at a spot which, according to hypothetical plans, should have been above the edge of the orchestra circle, south of its central point. After the upper layers of earth had been removed the digging was done with the most minute care by small groups of men under watchful scrutiny. Every stone larger than a pebble was cleared on all sides before its removal was permitted, and each section of hard earth was left untouched until a probing with a knife showed its exact nature.

Colors Still Bright and Fresh

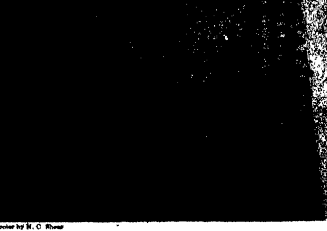
This slow and careful method had its abundant reward when the fragile nature of an important discovery of unique character that was presently made became apparent. About twenty-five feet below the surface of the ground a solid mass of hard-pan, the face of which was decorated with painted plaster, was uncovered. As this was at the bottom of a narrow pit, it was some time before the subject of the large-scale painting was revealed, but the laborers worked with zeal, and before the end of the season a total length of forty five feet of painted wall had been cleared. The discovery of any evidences of a bygone civilization famous in history and literature is an exciting event, but it is particularly thrilling, after digging through more than thirty feet of unproductive dirt, to come on a polychrome monument with its colors bright and fresh.

At a point in the circumference of the circle of the orchestra of the theater, opposite the center of the stage, is an opening, 3 feet 4 inches wide, on either side of which a wall is preserved to the height of 5½ feet. The front of the wall is covered with stucco on which are painted groups of life-size figures depicted as engaged in combats with lions. The main field of the picture, against which the figures are painted, is blue, below this are bands in two shades of yellow apparently representing the floor or ground on which the action takes place. This is bordered by a narrow band of dark blue, which, in turn, is separated by a pale pink strip from the broad outer border of dark red. This triple-colored border bounds the frieze, for it turns the corner and extends upwards along the vertical edge of the wall on either side of the opening.



OFFERING TO THE TEMPLE OF ATHENA

Metal bowl supported by ivory lions. Reconstruction was made by Prentice Duell



From a water-color by N. C. Shear

MOSAIC FLOOR IN THE ROMAN VILLA

Head of Bacchus surrounded by intricate designs made with tiny stones of many colors

From a drawing by N. C. Shear

A TERRA COTTA VOTIVE PLAQUE

Of the 4th Century B. C. A satyr in a startled attitude before a seated youth

THE EXCAVATIONS IN PROGRESS

Digging down to the orchestra of the theatre. In the left background is the temple of Apollo

LOOKING FOR THE TEMPLE OF ATHENA

A Byzantine house was uncovered in which was found a large jar of green glazed ware

On the left as one faces the passage is represented, as far as the wall has been uncovered (23 feet), a group of two gladiators fighting a lion. At the end of the wall, a man is standing, with his back to the spectator, facing a lion charging on him from the left. His feet are far apart, his knees are bent and he seems in the attitude of one poising a spear. Unfortunately the figure, like the others so far discovered, is cut off at the waist and the upper part is missing. The man is clad in a long purple undergarment, above which is a white cloak that is fastened by a rosette on the left knee. From the character of the costume it is evident that he represents some official either of the city or of the games. But whatever his identity may be, he is engaged with a doughty adversary in the huge tawny lion, which is rushing upon him in full course with both forelegs raised. Without doubt he has confidence in his own weapon and also in his companion, who stands behind the lion, facing the spectator, with his muscles tense and about to hurl his own lance at the beast.

On a section of wall of equal length, which was uncovered on the right side of the passage, the group again consists of two gladiators and a lion, but the figures are differently arranged. The first man, next to the edge, is running to the spectator's left, and apparently away from the combat, which the gladiator behind him is waging with a lion that advances on his left These men are dressed in one short garment, and have white sandals and white bands below the knees. It is difficult to realize the magnificence of this wall, which, when complete, was nearly nine feet high, and presumably extended around the entire circuit of the orchestra.

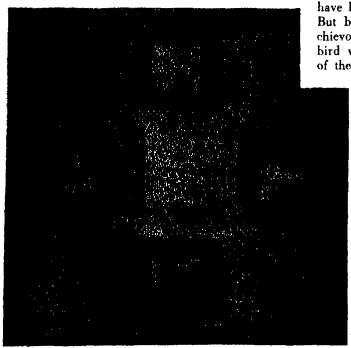
As the painted structure is built on the lines of the ancient Greek theatre, its history may be tentatively suggested. When the new colonists began to rebuild the city after the decree of 46 B. C., they used, as far as possible, the remains of former buildings. In the case of the theatre, the structural elements were available, but the plan of the lower part was altered to provide an arena suitable for gladiatorial contests This alteration was accomplished by removing some of the lower rows of seats, and by cutting the slope of the hill back to a high wall, which would protect the spectators from the contesting men and beasts, and at the same time enlarge the arena. With a liberal allowance of time for building activity in the restored city the date of this construction might be reasonably placed between 25 B C. and 25 A. D.

Proximity of Temple Indicated

As Herodes Atticus, in the second century A. D., erected the covered odeion near the theatre, it is possible that the reconstruction of the theatre itself was effected at the same time. This extraordinary polychromy is not mentioned by Pausanias and may have been already invisible at the time of his visit. But before it was covered from sight, some mischievous boy had scratched crudely in the stucco a bird with long feathers standing directly in front of the charging lion on the left wall, and above it printed his name in Greek letters. The major task of next season's campaign will be the uncovering of the remaining 300 feet of this remarkable wall.

When Pausanias describes his visit to the theatre section of Corinth, he specifically states that close to the theatre was located the sanctuary of Athena, the Bridler of Pegasus. In a search for this site, a trench was dug 25 meters long and 5 meters wide, running east and west along the Sicyon road, southeast of the theatre. Although the position of the sanctuary has not yet been definitely located, sufficient remains were found to prove the proximity of a temple, and excavations will be continued.

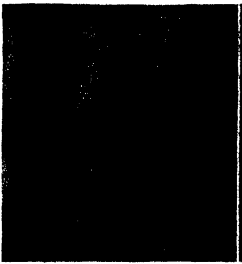
Among the objects discovered in this search for the Athena temple were several of the most important finds of the season. These included a deposit of small bowls, 160 in number, of which many were packed in superimposed piles, and all were evidently buried with care, as was frequently done with cheap, superfluous offerings when the treasury of a temple became overcrowded. Near this large cache of bowls were many ivory pins, which might have been appropriately dedicated to a female deity, and everywhere were vases and fragments of pottery of many periods. A lovely object that dates from the end of the 5th or the beginning of the 4th century B. C. is a small terra-cotta votive tablet with a representation in relief of a satyr dancing before a seated youth, perhaps Dionysus. The accurate modeling of



From water-colors by N. C. Shear

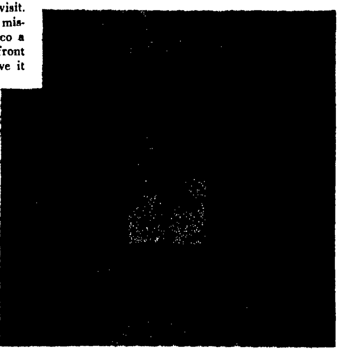
THE ATRIUM OF THE VILLA

The pool was open, the mosaic designs covered by a roof



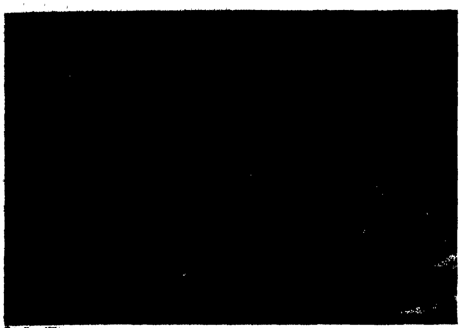
MOSAIC COPY OF A PAINTING

Panel from the atrium Probably represents Paris



A FLOOR IN THE VILLA

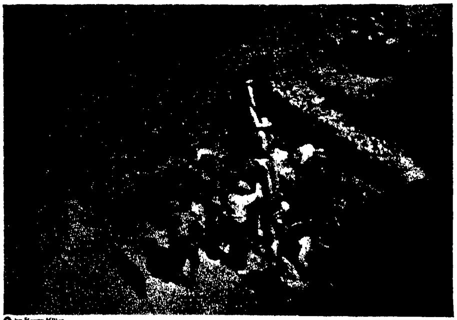
Figure of Bacchus with a thyrsus in his hand, set in frame



© by Henry Miller

THE ROOM WITH THE BACCHUS HEAD

The room is surrounded by a marble socle, above which the plastered walls are painted in a mottled pattern



© by Henry Miller

IN THE ORCHESTRA OF THE THEATRE

Clearing the wall on which gladiatorial contests are painted This work is done by laborers under supervision

the bodies, the beautiful folds of the drapery, the life and vigor of the execution mark this as a masterpiece. In the same vicinity was found an exquisite archaic ivory of the 6th century B. C. This is a figure, something over three inches high, in the shape of an upright lion, which served as one of the supports of some dedication of value, perhaps a small gold or silver bowl. It is a well carved work, and the surface of the ivory is perfectly preserved. In addition to other small objects, such as lamps and coins, heavy foundation stones of the Greek period were here uncovered and some large roof-tiles.

While the main excavation was in progress, it became necessary to despatch several workmen to a spot about a mile west of the theatre beside the Sicyon road to clear and protect a bit of mosaic pavement that was in danger of being washed away by a rivulet from a fountain close by This led to the discovery of a sumptuous Roman villa, of which five rooms were uncovered, all with mosaic floors of beautiful and intricate patterns.

The villa stands in a pleasant location, with the rich plain sloping in front towards the Corinthian Gulf, while in the distance behind rises the citadel of Acro-Corinth. It was supplied with excellent water from an abundant spring. At one end of the house the atrium, a large room 23½ feet square, has a square impluvium in its center, at each corner of which is a column base. The impluvium is a cement-lined pool, about a foot deep, that was open to the sky, while a roof, supported by the four columns, protected the rest of the room. On each side of the pool a picture is represented in mosaic, 3¾ by 3 feet, in size, which is surrounded by a frame consisting of a colored wave pattern within an elaborate meander design. The picture on the south side, which is perfectly preserved, shows a shepherd standing beneath an olive tree and playing a pipe, while to the right are three oxen, two standing and one lying down on the ground. There are remarkable attempts at foreshortening in the drawing of the cattle, and landscape is represented by a sloping hill in the background. As the youth wears a leopard's skin, this may be a picture of Paris portrayed as a shepherd on the slopes of Mt. Ida.

THE CITADEL OF CORINTH

The excavation in the auditorium of the theatre. In the background stands the Acro-Corinth

Head of Bacchus a Mosaic Gem

Opening from the southwest side of the atrium is a small room, 11 by 10½ feet, which has a mosaic gem on the floor. The centre of the design is an upright panel with a standing figure of Bacchus, who holds a thyrsus in his hand and has an ivy wreath in his hair. This panel is framed by the guilloche design that is used around all the pictures of the villa. The outside border about the room is a series of large black crosses, with four narrow red bands across each bar, set on a white ground. Then comes the rectangle of geometric decoration about the picture, with the colors all shifting in the repetition of the designs.

Northwest of the atrium, a doorway leads down to the large triclinium or dining-room, 23 feet square. In the center of this room is a panel picture of Europa on the bull, 4 feet square, framed by a series of decorative bands. Outside the picture frame, the entire floor is covered with a design of red and blue crescents with pointed projections in the center. The simplicity of this pattern is probably due to the fact that the floor was in large part concealed by dining couches placed about the room.

From the southwest corner of the triclinium, a doorway leads to a small room, 14½ by 11 feet in size, of which the mosaic floor is intact, and part of the frescoed wall is preserved to a height of one and a half feet. This room is the finest discovered in the villa, but the patterns are so complex that a brief description can give only an inadequate idea of the beauty of the designs. Bordered by decorative bands of intricate circular, crescent and diamond motifs is a square panel, about 7 feet square, in each corner of which a cantharus is represented with ivy or vines extending from it. Inscribed in this square is a circular frame of waved design, and within this are concentric circles of pyramids, variously colored, centering on a small inner circle, a little more than a foot in diameter, in which the head of Bacchus is portrayed.

Numerous objects of minor importance were found in this magnificent villa The extreme range in date for the coins is from the 3rd century B C. to the comparatively recent times of the Turkish occupation. There are vases of Roman date and potsherds of many types, some belonging even to the Proto-corinthian group. Among other finds worthy of mention are the stone spindle whorls, the ivory pins and the clay lamps. Three of the lamps are of a characteristic Corinthian shape with a square nozzle, and are made of the soft buff-colored Corinthian clay, which is covered by a white slip and is decorated with red bands A lamp of this distinctive type was also found in a well in the Athena trench, where the stratification of successsive deposits is fairly reliable. Near it was a coin of Agrippina, Jr., who died in 59 A. D, so that this type of lamp may be reasonably dated in the middle of the first century A. D At this time, Gallio was Roman proconsul in Corinth, and there, presiding over the tribunal he refused to hear the charges of the Jews against St Paul It is diverting to fancy that this villa may have been the suburban residence of the Roman governor of the province at that time.

A MONUMENT RESURRECTED

The painted wall was found buried beneath forty feet of earth The colors were still bright and fresh

The Scientific Study of Athletics

Our Bodies Are Machines, Whose Energy Expenditures May Be Closely Measured

By A. V. Hill

Professor of Physiology, University College, London, England Nobel Prizeman in Medicine

DURING severe prolonged effort an athlete's heart must be pumping out blood, to supply his muscles with the necessary oxygen, at a rate not less than 30 to 40 litres per minute—seven to nine gallons: and that against a pressure of about one-fifth of an atmosphere. As a matter of fact, the right and left chambers of the heart both expel the same amount, so that the total is really 14 to 18 gallons!

The pulse rate of an athlete, usually low at rest (50 per minute), is so responsive to the psychological effect of "go," and to the physiological stimulus of effort, that the very first beat after starting is measurably shorter than at rest, and the rate goes soaring up rapidly to 180 beats or more per minute, a level at which it may be maintained for considerable periods.

Lactic Acid and Fatigue

The long-distance runner may be breathing twice his own volume of air per minute. From this he may be taking into his blood some four litres of oxygen, about one gallon. This oxygen is utilized in the combustions which provide him with energy. Energy indeed is required: each member of the crew of an eight-oar boat may be developing 0.6 of a horsepower of actual mechanical work throughout a three-mile race: in a 100-yard sprint the muscular effort may be so intense that it would require an expenditure of total energy equivalent to about 15 horsepower to maintain it! In sprinting, lactic acid is being liberated in the muscles at the rate of four grams or more per second—an ounce in seven seconds: at the end of a 300-yard race there may be a quarter of a pound of this potent substance free in the tissues of the body, producing those very obvious symptoms which we call "fatigue."

The power expended in running increases about as the cube of the speed; that is why the highest speeds of running are so extremely expensive and exhausting. In running fast a man is always working wastefully: he is getting a velocity up to 20 miles or more per hour, as it were, on low gear. With artificial aids—a bicycle or an oar—he works on a higher gear with a smaller number of "revs. per minute," and recent studies have shown that in rowing, the frequency of movement—30 to 40 strokes per minute—is approximately that at which the greatest mechanical efficiency is realized. The boat and the oar have been evolved by long experience, to allow the attainment of that optimum.

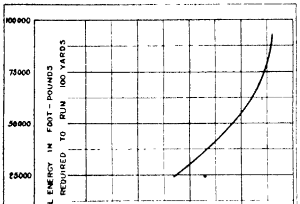


FIGURE 2

Total energy in foot-pounds required by the subject of Figure 1 to run 100 yards at various speeds

The magnitude of the bodily changes involved in severe exercise is such that it is difficult at first to appreciate their importance. Considerations of energy are of course not the only factors: athletics is not merely biochemistry: that is obvious. But it is obvious also that energetics and biochemistry present the framework on which all the other activities depend.

When a muscle is stimulated, a certain amount of lactic acid is liberated at certain surfaces within it. This, by some physical or chemical process still uncertain, causes a development of force and, if allowed, a shortening of the muscle. The acid is then rapidly neutralized, its effect passes off, and the muscle relaxes. The process can be repeated again and again until the available supply of alkali for neutralizing the acid has been used up, when the rapidly increasing acidity of the muscle stops its further activity. This stage is that of complete fatigue, and the amount of work which the muscle can perform depends on the degree to which it can tolerate acid before this stage is reached.

FIGURE 1

The subject of the experiment, having run 120 yards, collecting his expired air in a bag

The acid, moreover, which accumulates has many effects before further activity has become impossible. It excites the "respiratory centre," a portion of the brain which controls the breathing, it regulates the amount of oxygen utilized by the body; it slows the relaxation of the muscle. This last effect is very striking in short distance races, where slower muscular relaxation, commencing within seven or eight seconds from the start, causes a progressive diminution in the maximum speed long before exhaustion.

This formation of lactic acid is the chemical reaction on which the whole of voluntary muscular activity depends. Just, however, as an electrical storage battery requires recharging after use, to restore its power of supplying current, so the muscle needs to be restored to its previous state; its lactic acid must be transformed back to its precursor, a process requiring a supply of energy. This energy comes from the combustion of foods by oxygen supplied through the lungs and circulation.

All the oxygen used by a man during and after muscular exertion is employed in this "recovery process." When the effort is very severe and of short duration the whole of the oxygen used may be consumed after the exercise is over. During long continued moderate exercise a balance may be attained between new formation of acid and restoration of that previously liberated.

The capacity of the body for long continued effort depends, among other things, upon the maximum available supply of oxygen, while the capacity of the body for short-lived, violent effort depends chiefly upon the maximum amount of acid which can be tolerated by the muscles. The amount of lactic acid present can be measured by the volume of oxygen required, in recovery, to effect its removal. This quantity has been called the "oxygen debt." The capacity of the body for exercise depends, therefore, (a) upon the maximum rate of oxygen intake during exertion, which is determined by the efficiency of heart and lungs, and (b) upon the maximum oxygen debt which the body can tolerate. These maxima are fairly well established for athletic men of average size. (a) is about four litres per minute, (b) is about 15 litres.

Results Are Beyond Dispute

The oxygen requirement of running at various speeds can easily be measured. The subject runs about 100 yards at any required speed, holding his breath the while, and at the end lies down at once upon the ground and allows all the air which he breathes out to be collected in a bag for a period of about half an hour. A measurement of the volume and an analysis of the contents of the bag give us then the oxygen used as the result of running 100 yards at that speed. A photograph of a subject and some of the apparatus is shown in Figure 1. The results obtained on him are given graphically in Figures 2 and 3. From the curves, and from other data known for this subject, a very interesting calculation can be made.

To make the matter clearer, quantities of oxygen used may be expressed in terms of total energy set free. One litre of it corresponds to about 15,600 foot-pounds of energy liberated. In an uneconomical process such as running, a small fraction only of this energy appears as mechanical work; the rest is wasted as heat. Recent experiments on the subject of Figure 1 have shown that the relation between the total energy used in running 100 yards and the speed of running is that shown in Figure 2.

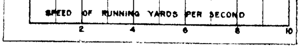


FIGURE 3

This chart shows the rate of expenditure of total energy, in horsepower, in running at various speeds

The amount of energy used at the higher speeds is astounding: 80,000 foot-pounds are required to run 100 yards in 11 seconds—enough (if employed with a mechanical efficiency of 25 percent) to raise the subject's body (about 140 pounds) 144 feet into the air. In spite, however, of their astonishing nature, there can be no doubt at all of the general truth of the facts shown graphically in Figure 2: the experimental results are clear and beyond dispute and emphasize the energetic nature of sprint running.

The matter can be expressed in another way. We may calculate the *rate* of expenditure of energy and express it in horsepower, or kilowatts. Again it must be emphasized that this horsepower—these kilowatts—do not represent actual mechanical *work done* but only the *total energy* available in the chemical processes resulting from the exercise. The chief part of this power is wasted in warming the body The results are shown in Figure 3. These again are astounding: 13 horsepower is being exerted during the process of running 100 yards in 11 seconds· 16 horsepower in running it in 10⅘ seconds, which is the fastest we have recorded on our subject.

Timed Throughout a Run

Let us make a further calculation. When his oxygen intake has been raised to its maximum by severe exertion, he can consume about 3¾ litres per minute. This corresponds to a steady liberation of total energy at the rate of 1 77 horsepower. His maximum oxygen debt is 16 3 litres, which corresponds to 7 68 horsepower exerted for one minute, or 3.84 horsepower for two minutes, or 2 56 horsepower for three minutes, and so on. Thus, if he runs for a short time only, and expends all his "capital," he has available a far greater supply of power than if he has to run for a longer time and so to spread his "capital" over a longer interval. By proceeding in this way we may calculate that this particular subject can run various races in the following times·

Distance	300 yds	¼ mile	⅜ mile	½ mile	¾ mile	1 mile
Time calculated...	32 4″	52″	1′ 15″	2′ 4″	3′ 22″	4′ 44″
Time observed .	34″	51⅗″	1′ 15″	2′ 2″	....	[illegible] 40″

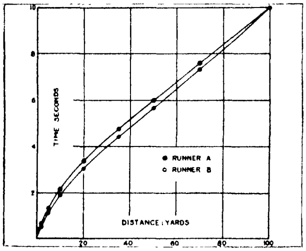


FIGURE 5

The relation between the time and the distance covered by two imaginary runners, A and B, dead heating in 100 yards Such observations can readily be made by the method described in this article

The last row of figures gives the actual best times he has recorded: there is no doubt of the striking general agreement between "calculated" and "observed." We are correct therefore in ascribing the variation of speed with distance mainly to factors of energy and oxygen.

In organizing a sports meeting one of the problems is to allow sufficient intervals between heats and finals, and between different races in which the same runner may be performing. Recent studies of the rate at which the recovery process after exhausting exercise occurs in normal healthy men have shown that recovery is not quite complete until some 60 or 70 minutes have passed. In general, the more exhausting the exercise, the longer will be the recovery

It is clear, however, from the curve of Figure 4 that the major portion of the recovery process, even after exhausting exercise, is completed within a comparatively short time Five minutes after such exercise the recovery has proceeded to 46 percent completion: ten minutes after to 64 percent twenty minutes after to 80 percent. Obviously, therefore, in short distance races by trained men, no great harm is done by allowing heats to occur within twenty minutes or so of one another. In order, however, to attain the absolute maximum of performance it would seem advisable to allow at least three quarters of an hour (95 percent recovery) between semi-finals and finals.

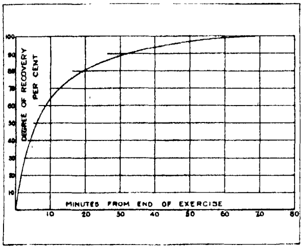


FIGURE 4

The course and duration of the recovery process after severe exercise lasting for several minutes the recovery is measured by the amount of oxygen used in it, the total amount being called 100

It has long been obvious that electrical methods would be far more accurate than those usually employed for timing races. Their apparent complexity and expense, however, together with the conservatism of governing bodies, have prevented their adoption hitherto. Moreover, if only the *total* time in a race is to be taken, the information obtainable seems scarcely of sufficient interest, either to athletes or to scientists

It is entirely a different matter, however, if times can be taken with accuracy at intervals *throughout a single run* Let us imagine, for example, that the moment at which the pistol is fired and that at which *a runner completes* 2, 5, 10, 20, 35, 50, 70 *and* 100 yards can be recorded, in each case accurately to 0.002 sec Such times for two imaginary athletes A and B, are recorded graphically in Figure 5. Clearly by such methods all kinds of questions can be answered. The lag of taking off, the initial acceleration, the maximum speed. the rate at which the velocity decreases later, the onset of fatigue, can all be ascertained. From Figure 5 we can further construct Figure 6, showing the velocity of our two imaginary runners throughout their race They finish with a dead heat, A has started much more slowly than B, he attains, however, finally a greater velocity than B which also he is able to maintain, while B's velocity begins rapidly to diminish

FIGURE 7

Records made on a string galvanometer of the moments at which a small magnet passed through a large coil of wire When such a coil is erected over a track and the magnet carried by the runner, the times of passing through all the coils may be recorded accurately

For actual runners, no doubt, the curves would be different from those shown in these figures In general, however, such curves and such differences would appear, and it is obvious that the record is a characteristic for any particular individual

Are such accurate measurements possible? Indeed they are, and by comparatively simple methods Figure 7 shows a photographic record, made on a string galvanometer, of the moments at which a small magnet held in a man's hand was passed rapidly to and fro through the middle of a large coil of wire, wound round a frame 7½ feet high and 4½ feet wide, standing vertically in a passage in the laboratory Such a coil can equally well be mounted in a field and connected to a galvanometer located in the pavilion

Two Runners Timed Together

Similar records can be made by attaching a small magnet to a cap worn on the head, or by sewing a thin magnetised wire, six to nine inches long, on a man's clothing. Eight such coils, arranged in series along an experimental running track, would give eight such records on the photographic paper, the intervals between them being measured by comparison with the cross lines of an accurate time-marker The moment at which the center of the magnet passes through the coil can be read to 0.002 sec. from the point A at which the record crosses the base line There is nothing to impede the runners, the track is clear, the coil is merely an archway over it, the pistol can be recorded by a microphone coupled with the coils There are no wires to break, the magnet need weigh only an ounce or two, the pistol is fired, the run is completed, the photograph is taken, and within five minutes or so the record can be developed, worked out, and, if desired, plotted in a curve like that of Figure 5

The expense of such a permanent installation would be only 1,000 to 1,500 dollars Its use need not be limited to short races a quarter mile track could easily have eight or ten such coils erected along it, so that all races could be timed and recorded with the same degree of accuracy. Two runners could be timed together throughout a race, by the simple device of arranging their magnets in opposite directions, so that their records, also in opposite directions, could be distinguished from one another

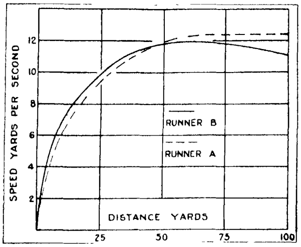
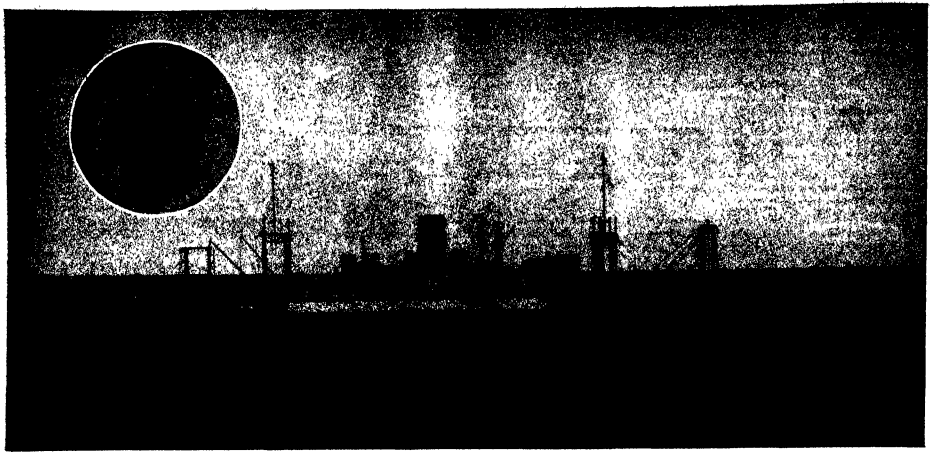


FIGURE 6

Deduced from Figure 5 Speed at various points during a 100 yard race of two imaginary runners, A and B A starts slower than B, but attains a higher maximum speed and maintains it longer

Such an installation would prove a most valuable tool in the scientific study of athletics.



THE RESCUE SHIP, *ROOSEVELT*, AND HER HEROIC CAPTAIN

Length, 516½ feet; breadth, 72½ feet, freeboard, 32 feet; draft, 27 to 30 feet; gross tonnage, 14,187 tons; maximum sea speed, 20.04 knots

Heroism on the High Seas

An Epic of the Daring, Skill, and Self-sacrifice of American Sailormen

By J. Bernard Walker

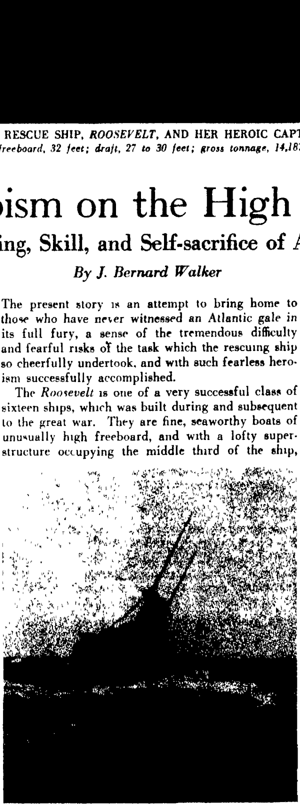
SEARCH the long records of the world's merchant marine and you will find no story of the saving of life that has made a wider appeal to the world than that of the rescue by the American ship *Roosevelt*, during a furious Atlantic gale, of the crew of the British ship *Antinoe*. Times without number, ships have stood by a disabled vessel and taken off its crew in heavy weather, and during the series of gales which overtook the *Antinoe*, there were, as a matter of fact, no less than six rescues of this kind. But, there were features of daring and dogged determination connected with the rescue of the crew of the *Antinoe*, which, by common consent, have placed this epic of the "roaring forties" in a class by itself

Why This World-wide Acclaim

There are two outstanding facts, which account for the world-wide acclaim. First, the dogged perseverance with which Captain Fried, in raging seas and blinding snowstorms, and at imminent risk at times to his own ship, clung to the disabled vessel for four days on end. He lost her and found her again, and after trying every possible plan of rescue, and losing two men and six of his boats, finally transferred every one of the shipwrecked crew aboard his own ship. The other outstanding fact is that, undaunted by the loss of two heroic members of the crew of the *Roosevelt* in the first attempt at rescue, more than sufficient volunteers were found to man the boats under First Officer Miller, and make the final trips which were successful in bringing off the twenty-five men aboard the wreck.

It is not the purpose of the present article to tell in detail the story of this amazing rescue. That has been done so fully as to call for no repetition here. The present story is an attempt to bring home to those who have never witnessed an Atlantic gale in its full fury, a sense of the tremendous difficulty and fearful risks of the task which the rescuing ship so cheerfully undertook, and with such fearless heroism successfully accomplished.

The *Roosevelt* is one of a very successful class of sixteen ships, which was built during and subsequent to the great war. They are fine, seaworthy boats of unusually high freeboard, and with a lofty superstructure occupying the middle third of the ship, devoted to passenger accommodations. The *Roosevelt* is 516½ feet long; 72½ feet broad and 28 feet deep. She carries 436 passengers and a crew of 223, stows a cargo of 5,000 tons and is rated at 14,187 gross tons. Although she looks somewhat bulky above the waterline, she has a fine underwater model. She has made the trip from Queenstown to New York at an average speed of 20.04 knots—a fine performance. A noticeable feature about the ship is her high freeboard which measures 32 feet to the main deck and 62 feet to the boat deck. This freeboard was both helpful and a handicap during the work of rescue.



THE DISABLED *ANTINOE*

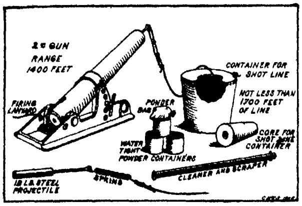
This little ship, 2,079 tons, is sinking. The boats are gone, hatches stove-in, steering gear disabled and fires out

Seas Crashed Down on *Antinoe*

The *Antinoe* was a very small boat as things go today, being only 280 feet in length and of 2,079 tons. She was a "three-island" boat, with forecastle, amidships superstructure, and poop. Loaded as she was when disaster overtook her, her freeboard in the wells between the raised decks can have been only a few feet. So long as nothing gives way, such a ship can make fairly good weather in an Atlantic gale when riding head to the seas. But the steering gear broke, the little ship swung off into the trough of the seas, the giant combers came crashing aboard, hundreds of tons of water at a time, splintering her wooden hatches, filling the engine and boiler rooms, and putting out the fires. She was in this condition when her cry for help came over the waters and was heard by the wireless operator aboard the *Roosevelt*.

When the message was received, both ships were probably out of their estimated positions, for both of them had been running by dead reckoning. The *Antinoe* was 100 miles out. It was due to that marvelous instrument—the radio compass—that Captain

Fried was able to find the ship in all that fury of wind, sea and driving snowstorms. He reports that he found the ship in a bad way and that in answer to his signal "Do you wish to abandon," they replied, "Not yet, thank you, wish to try making repairs and secure hatches. Please stand by." When later they asked to be taken off, the boats were gone, eight feet of water was in engine and fire rooms, and with a list of 40 degrees, the lee rail was under water. Her condition is shown in the accompanying photograph taken from the *Roosevelt*. The wireless was gone and communication was made by signal flags in the day time and by a dollar flashlight at night.



THE LYLE GUN

The 18-pound projectile, attached to 1,700 feet of light line, has an extreme range of 1,400 feet. The gun is fired with smokeless powder. To the left is a shot with coil spring, designed by Colonel Hearn

The *Roosevelt* herself was rolling 30 degrees and taking green seas aboard, and Captain Fried reports "there was also the danger of running into the *Antinoe* because we could not see very far." As night came down, they lost sight of the wreck and for nineteen hours the *Roosevelt* kept up the search, picking up the ship again at 3:40 P.M. the next day.

It should be stated that on first finding the ship Sunday evening, the *Roosevelt* placed herself to windward and discharged oil overboard to smooth down, as far as could be, the breaking seas. This discharge of oil was made when she found the ship again, and at once a boat was lowered. A sudden squall swept round the bow, a steep sea threw the men out of the boat, and it was with great difficulty that six of them were rescued. In spite of every effort, however, two gallant fellows, Master-at-Arms Witanen and Boatswain's Mate Heitman were swept away and drowned.

The *Roosevelt* continued pumping oil overboard through the night, and at noon the next day, attempted to get a line aboard the *Antinoe* by means of the Lyle gun. Ten shots were fired. Then a lifeboat was lowered and drifted under the *Antinoe's* stern, but her crew could not hold her. On the morning of Wednesday, rescue work commenced again. Three attempts were made to lay a lifeboat alongside the wreck, and finally a line was shot across the *Antinoe*, and a lifeboat was made fast to a stronger line which had been hauled aboard the wreck; but the line parted and the boat was lost. An attempt was made to get a line to the *Antinoe* by floating it across the seas attached to a cask; but the line sagged and the cask was unable to carry it to the ship.

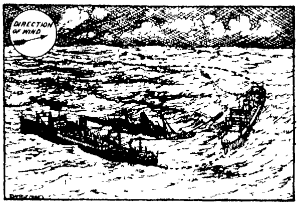
Captain Fried then tried the daring maneuver shown in one of our drawings. He steamed to leeward of the wreck, put overboard a lifeboat, and made fast the inboard end of the rope to the top of an after-kingpost at an elevation of 75 feet above the sea. He then steamed past the stern of the *Antinoe* and swung sharply around to weather of her, hoping thereby to draw the tow rope over her stern, but the rope sagged in the water and passed under instead of above the wreck.

Carrying Lines to *Antinoe*

The Lyle gun, as shown in one of our illustrations, is the standard type used by lifeboat service in rescuing stranded ships by means of the "breeches buoy." The gun has a bore of about two inches. The shot is about 18 inches in length with a steel rod of about the same length projecting from one end. To the rod is attached a light, cotton line. The line, about 7,500 feet in length, is coiled inside a tub-shaped container. After the shot leaves the gun, the drag of the line causes the shot to reverse itself, so that it travels through the air with the shot first and the rod and its attached line trailing after A ship ordinarily carries from three to five of these lines. After these had been shot away, Captain Fried had to use any small line that he happened to have aboard, and the sudden pull on the lines caused them to break. Colonel Hearn of the Army, who was a passenger, suggested placing a coil spring between the projectiles and the line, so as to absorb some of the initial energy and start the line more gradually. This proved to be successful.

The upper right-hand picture shows the daring maneuver by which Captain Fried attempted to carry a line across the stern of the *Antinoe*. The lower left-hand cut shows the shooting of a line, an attempt to drag a lifeboat from the *Roosevelt* to the *Antinoe*, and the attempt to float a line down to her by means of a cask.

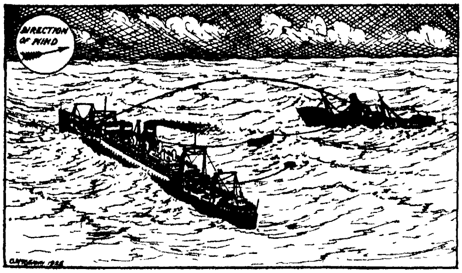
Now, just here we wish to emphasize the great risks which Captain Fried did not hesitate to undertake in his dogged determination to save the shipwrecked crew. In the first place, it must be remembered that a gale of terrific force was blowing, and that seas, at 30 to 40 feet high, were running. Engineers on shore in designing big bridges and tall buildings, use a unit pressure of 30 pounds per square foot in estimating the total maximum wind pressure for which they must make provision in designing their structures. Now, the *Roosevelt* in placing herself broadside to the seas and to windward of the *Antinoe*, presented a total area of about 22,000 square feet of surface to the wind, and a simple calculation shows that she was, therefore, pushed to leeward with a pressure of 300 tons or more on her hull structure alone To oppose this was her submerged hull with a draught of 27 to 30 feet. The little *Antinoe*, with her main deck flush with the water, was drawing probably as much water as the bigger ship, and since her area above water was very limited, she was probably making only about one-third of the leeway of the *Roosevelt*. Nevertheless, Captain Fried did not hesitate to place himself within a few hundred feet of the wreck. Had his engines broken down, or if he carried insufficient way upon his ship, he would have been in imminent danger of drifting too close and of being lifted on one of the enormous seas and dropped upon the *Antinoe*. That would have meant the loss of every soul on both ships.



A DARING MANEUVER

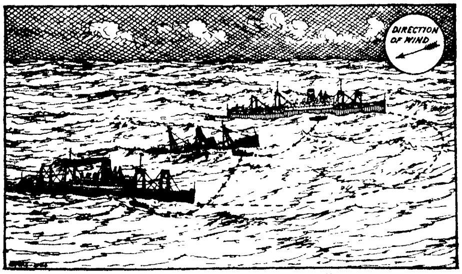
The Roosevelt, *towing a lifeboat from lofty kingpost on the* **quarterdeck,** *crosses the stern of the* Antinoe, *swings sharply around and takes up a position to windward, trying to carry line over wreck*

In considering the two final and successful attempts, we must remember that a lifeboat in such weather can make progress only down the wind. Hence the *Roosevelt* was placed to weather of the *Antinoe* and the boat was lowered from the leeward side First Officer Miller brought it under the lee bow of the *Antinoe* and took off the men. Meanwhile, the *Roosevelt* steamed to leeward of the wreck, and the lifeboat, still pulling down the wind, fetched up to leeward of the *Roosevelt* and transferred the rescuers and rescued to that ship Twice was this maneuver carried through—the second time by moonlight.



ATTEMPTS TO GET BOAT TO THE *ANTINOE*

Various attempts were made to rescue the crew. Sixteen lines were thrown with the gun. Boats were floated or drawn over. A line was floated down by a cask



THE FINAL RESCUE IS ACCOMPLISHED

The Roosevelt *steams to windward, her boat pulls under lee bow of wreck, the* Roosevelt *steams to leeward of the* Antinoe, *where she recovers the men from the boat*

Our Point of View

Wasting Our Patrimony

IN the present issue we commence a series of articles designed to show with what extravagance we have wasted our national patrimony as represented by the rich natural resources with which Nature has endowed the territory of the United States. The wealth and general prosperity of the country are largely due, of course, to the intelligence and energy of its people, but it can hardly be disputed that it is equally due to the natural wealth of the country

It seems as if Nature must have said, I will prepare a land, which, in respect to the necessities of life and the conditions for the upbuilding of a highly civilized people, shall be absolutely self-contained. I will cover its surface with the richest of soils, watered by majestic rivers and clothed, in great part, by forests, which in the variety and magnificence of their timber, shall be unapproached elsewhere on the planet. Underneath the surface, I will lay up practically inexhaustible stores of fuel, both coal and oil. And in readiness for the great industrial age, which will come in due course, I will enrich this favored land with vast accumulations of metalliferous rocks so readily accessible that, in the case of iron, the ores can be shoveled up by the millions of tons and drawn away in train loads to the smelting furnaces.

It is a priceless patrimony; but, alas, with all the extravagance of the thoughtless youth who comes suddenly into a vast fortune, we have expended our riches as though they were absolutely without limit—which they are not. It is only of late years that we have been moving to a full realization of our youthful extravagance. We have learned these facts a little late, but not too late. It remains for us to put into practice those principles of thrift and conservation, which have long been practiced by the older civilizations of Europe.

This series of articles, of which the first appears in this issue, will constitute an extensive survey of our natural resources, showing what we have spent of our patrimony, how much of it remains, and how we can best conserve the remainder and prolong to a far-distant day the date of its exhaustion.

Burn Your Smoke

NOT many years ago, the atmosphere of the city of Pittsburgh was so thick with smoke that, to any visitor from an anthracite-burning city, the place was a horror. Your snow-white collar of the morning was an unholy smudge by noon, and your immaculate cuffs would cause a tramp to look upon them with a dubious eye Milady's dainty fabrics were quickly soiled by the universal soot, and no matter how fair the outside of your office building or your picturesque home, its freshness and charm, both inside and out, vanished, only too soon, under the intimate caresses of the smoke-charged atmosphere. Today, Pittsburgh is a clean city and gets its full share of sunlight and unadulterated breezes, for it has learned to burn its smoke

Some thirty years ago, the writer found himself on the footplate of the engine that hauled the fast train carrying the transatlantic mails from Queenstown to Dublin He noted that the engineer, in addition to keeping a lookout for signals, had his left hand on a lever which opened and shut the laterally sliding doors of the fire box As the fireman swung a shovelful of coal toward the furnace, the engineer would snap the doors open, and then close them very gradually with a slow movement of the lever. We asked him why he shut the firedoors in such leisurely fashion. "I am burning the smoke, sir," he answered, "watch the smokestack." We had already noted that there was a complete absence of smoke. Immediately after the next shovelful was thrown in, he closed the door with a sharp snap and at once a dense volume of black smoke poured forth. He told us that he and the fireman were paid a certain sum for every ton of coal that they saved below a definite fixed amount which was allowed them for the round trip, and that careful firing meant a considerable addition to the pay envelope.

The recent coal strike was rapidly shrouding many of the cities of the United States with a pall of smoke which threatened to reproduce the unbearable conditions that prevailed in Pittsburgh before that city had learned to consume the smoke of its fires and furnaces, and though the strike is over, a wise public will not soon forget the warning. With the passing of the weeks, the conditions were becoming increasingly serious. Buildings were discolored, wearing apparel and fabrics in the home ruined, and the health of the inhabitants—so the Boards of Health had told us—was being seriously jeopardized. Now all damage and discomfort of this kind is easily preventable Most of it can be avoided by admitting above the bed of glowing coals sufficient air to provide the oxygen for burning the gases before they escape to the chimney or smokestack. A little patience on the part of the citizen in his home, or of the fireman in the factory will enable him at once to burn the smoke and get the full, or practically full, heating value out of his coal.

Brotherhood of the Sea

It is an age-long tradition of the sea that, although the sailorman outwardly may be brusque, more often than not he hides within him the gentleness of a woman and the heart of a lion. There is something in the sea that softens and broadens a man, and breaks up the shell of selfishness with which he becomes so sadly encrusted on shore. Never is this emancipation so strikingly manifest as when the cry for help comes over the waters. Then it is that the sailorman—be he captain or common seaman—will rise unconsciously to the heights of great heroism. In that hour, all the barrier walls of race, creed and social distinction fall down and man is seen standing in all his naked, God-imaged splendor. The four-day fight of the captain and crew of the *Roosevelt* to save the crew of the *Antinoe* (to say nothing of the many other glorious rescues of the recent storms) is a saga of the brotherhood of the sea that will be sung, and sung again, by the generations to come.

Is the Skyscraper Safe?

A WELL-KNOWN architect in a letter to one of the leading "dailies," has sounded a note of warning with regard to the safety and permanence of the modern so-called skyscraper. He suggests that the steel structure, which is hidden from sight by its covering of cement or tiling, or both, may be subject to oxidation on its surface or molecular changes within, which, in the course of time, may bring about its collapse. As a precaution, he suggests that from time to time the covering of the steel should here and there be removed sufficiently for inspection.

As a result of certain reassuring facts which have been well-established by investigation and experience, we think that such a warning as this is not only unjustified but most unfortunate; since it may shake the confidence of the public in a form of construction in which, as a matter of fact, they have every reason for the fullest confidence. In the first place, on the tearing down, to make way for larger structures, of several skeleton-steel buildings that were erected many decades ago, it was revealed that the steel was in perfect condition in every case where it had been carefully covered in at the time of erection. It is a simple matter—a mere question of careful oversight by the foreman and the architect, so thoroughly to protect the steel against moisture that any future oxidation of the metal is out of the question. Where this has been done, the life of the steel frame may well run into the thousands of years, for the risk of the steel failing through molecular changes, or through "fatigue," simply does not exist. If the stresses in the framework were dynamic (as in the case of earthquake shock), and were continually recurring, there might be some point to this warning; but the stresses are static, except for some variation of load under wind pressure, and the steel can carry these stresses indefinitely. Good design and careful inspection should render a tall office building as lasting as the pyramids themselves.

Better Tools—Better Men

THE present widespread discussion of the handicaps and hardships of farm life is liable to overlook certain important facts of the problem It is undeniable that, judged from the standpoint of the city dweller, the day-by-day life of the farmer is monotonous and hard; although, to tell the truth, it has no such monotony and is not nearly so hard as it was two or three decades ago. The automobile, the telephone and radio have gone far to banish loneliness and ennui from the farmer's life Nevertheless, it cannot be denied that much of his daily labor is over hard and woefully monotonous.

There is, however, a remedy at hand, if the farmer will but use it; for just as electricity, through the telephone and the radio, has brightened his home life, so the same agent can take much of the hardship out of his work in the field, in the barn and in the woodshed. Furthermore, what electricity can do for the farmer, it can do also for his wife. The domestic drudgery that falls to the lot of the wife on the farm is proverbial; but for her, as for her husband and sons in the field, there is promise of emancipation in those many efficient labor-saving appliances—the electrically-driven washing machine, sewing machine, cleaner, and churn—which applied science has brought within reach, and will supply when the rural population demands them.

Although the drift of the farm population to the cities is due largely to the desire for the comforts and recreations from which the farm family is so largely shut out, it cannot be denied that the stronger motive is the above-mentioned growing antipathy to the drudgery of farm work. Hence, we repeat that the extensive use of electricity on the farm would go a long way, in stabilizing and rendering content our rural population.

A Stellar System 700,000 Light-Years Away

How the Distance to N.G.C. 6822, Containing Millions of Suns, Was Measured

By Henry Norris Russell, Ph.D.
Professor of Astronomy at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

AT various times we have had occasion to speak of the remarkable advances which have been made in recent years in sounding the depths of space. Another notable example of such work deserves our present attention.

In the constellation Sagittarius, in 19 h 41 m right ascension and 15 degrees south declination, the late Professor Barnard in 1884 discovered a faint diffuse nebula which later received the number 6822 in Draper's "New General Catalogue" of nebulae, and is therefore commonly known as N. G. C. 6822.

This object is so faint and extends so far over the sky that as a whole it can be seen better with a small telescope than with a large one. The small instrument with its wide field of view brings out the contrast between the faint luminosity and the darker sky surrounding it. The small field of a larger telescope falls entirely within the luminous area, so that there is nothing for the observer to notice. With a very large instrument, certain finer details—too small to be seen with one of moderate size—become visible. Between the small and very large telescopes there is a "blind zone" of instruments with which neither the object as a whole nor its detail can be seen.

The "Blink-comparator"

The real nature and remarkable character of the object was first revealed by photographs made by Duncan at Mt. Wilson in 1921 and by Perrine at Cordoba, Argentina, in 1922. These plates, made with powerful instruments, revealed it as a cluster, a "cloud" of vast numbers of exceedingly faint stars, accompanied by patches of thin nebulosity—the whole view resembling a miniature of the Magellanic Cloud.

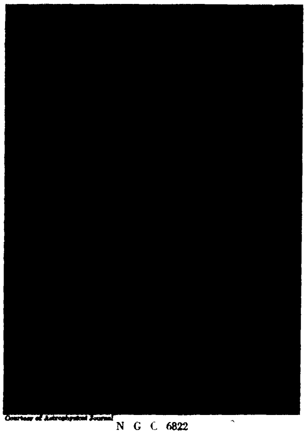
The small size of the star-cloud, only about 20′ by 10′, with a central core 8′ by 3′—and the extreme faintness of the individual stars, suggested at once that the system was very remote. A careful study was therefore commenced by Hubble, whose detailed discussion—just published—forms the basis of the present article.

The brightest stars of the cloud appear to be of about the 16th magnitude (photographically). Visually, they are probably of somewhat brighter than the 15th magnitude since, like the brightest stars in the star-cluster, they are red. The few scattered stars in the field, which are brighter than this are no more numerous than might be expected in any neighboring part of the sky, and are doubtless "foreground" stars, far nearer than the rest.

Down to magnitude 19.4—which is as far as good measures of brightness could be made—there appear to be about 750 stars in the cloud. The numbers increase very rapidly as the stars grow fainter, and there must be thousands of still fainter stars visible on long-exposure photographs with the great reflectors, although too faint to measure accurately.

More than fifty photographs of the cloud have been made with the great telescopes—the large number being necessary in order to search for and to study variable stars. Fifteen of them have been found within the cluster and more outside it—so that they must really be members of the group.

To discover one star of variable brightness among hundreds which do not change would be like looking for the proverbial "needle in a haystack" if it were not for the aid of the "blink-comparator." This very ingenious instrument consists of a pair of low-power microscopes set a couple of feet apart, with optical devices to bring the images from both to a single eyepiece. Two plates are placed in cameras, one under each microscope, and may be shifted by suitable slow motions until the images of the stars on the two plates, seen through the two optical systems, come into coincidence. A little lever enables the observer, by turning a small mirror, to see first one and then the other of the two plates.


Courtesy of Astrophysical Journal

N. G. C. 6822

Photographed by the 100 inch reflecting telescope at Mt. Wilson Observatory. Three and one-half hours' exposure

If the adjustments are correct, the change through substituting the star-images on one plate for those on the other, will cause no shift in their apparent positions. Every star, however, which has moved or has changed in brightness between the dates of the two exposures, will appear to "blink"—shifting in position, or changing in size in a remarkably conspicuous manner.

This makes the discovery of variable stars relatively easy—although, even so, the amount of work involved in taking dozens of plates with long exposures, and going over them, star by star, under the blink-microscope is by no means small.

When variable stars had been discovered, the work had only begun.

A standard scale of stellar magnitudes must be determined—by comparison with the "selected Areas" in which the brightness of the stars has been carefully measured—which required about a dozen special plates with double exposures, showing both fields on the same plate.

Then the magnitudes of the individual variable stars on each plate were measured. It appeared that the large majority of them—eleven, at least, out of the fifteen—showed regular periodic changes in brightness of the familiar Cepheid type with continuous variation, a rapid rise and a slow fall, with a range not exceeding one magnitude.

The periods of variation range from 64 days to 12 days. The magnitude at maximum ranges from 17.5 to 19.1 and—as is the case in other clusters—the stars with the longest periods are the brightest.

The relation between brightness and period is almost exactly the same as that which has been found by Shapley for Cepheid variables in other regions, but, for the same period, the stars in N. G. C. 6822 are apparently very much fainter. There can be no doubt of the meaning of this—the system is farther away. In fact, the variables are all about 21.6 magnitudes fainter than similar variables would be if placed at the standard distance of ten parsecs (or 32.6 light-years). From this it follows that the distance of the star-cloud has the enormous value of 214,000 parsecs, or 700,000 light-years.

The mere hope of measuring so vast a distance would have appeared wholly chimerical a couple of decades ago, but the evidence upon which our present methods are based is so strong that there can be no doubt of the substantial trustworthiness of the results.

Millions of Stars

More accurate measures (particularly of the real brightness of those Cepheid variables which lie relatively near the sun) may alter our compiled distances by twenty percent, or perhaps a little more, but the general character of the figures is not at all likely to be altered.

With this distance, it follows that N. G. C. 6822 is about 1,200 parsecs long by about half as wide—that is, it occupies a space great enough to include at most all but the very remotest of the stars visible to the naked eye, but small compared with the dimensions of the Milky Way. The denser central portion is about 500 by 200 parsecs.

The brightest stars in the cloud are about thirty thousand times as luminous as the sun, and therefore comparable with the brightest objects known in other star-clouds and among Galactic stars near the sun.

The total light of the system corresponds to the absolute magnitude—12.7—that is, to about twenty million times the light of the sun, and the total number of stars—most of them far too faint to be photographed—must run well into the millions.

Some of the small nebulae which can be seen and photographed here and there within the star-cloud have gaseous spectra and doubtless belong to the cloud. Their actual dimensions must be very great—averaging 120 light-years in diameter—but not greater than those of some of the nebulae in the Magellanic Clouds.

Most impressive of all to the imagination is the fact that there are a good many other "irregular nebulae" outside the Milky Way, which look very much as N. G. C. 6822 would do if removed to a still greater distance. Dr. Hubble says expressly that this object of his studies may be regarded either as the remotest star-cloud so far known or as the nearest of the irregular non-Galactic nebulae.

Distances up to at least three or four times that of N. G. C. 6822 can be measured by the present methods, and it is probable that more of these great star-clouds will, before long, yield up their secrets.

Photograph by Jennett Spencer Courtesy of "American Forests and Forest Life"

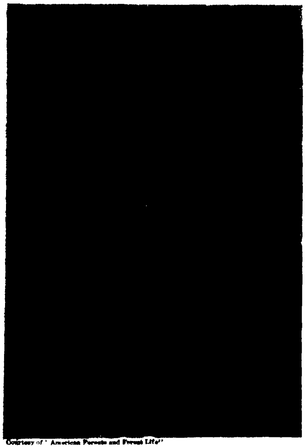
A PATHETIC WITNESS TO THE APPALLING DESTRUCTION WROUGHT BY FOREST FIRES

Uncle Sam, Spendthrift—I

The Magnificent Forests Which Once Covered the Greater Part of the United States Have Largely Been Swept Out of Existence

By J. Bernard Walker

WHEN the Pilgrim Fathers first looked with eager eyes upon the coastline of the New World, they noted that it was heavily forested down to the very water's edge. The Dutch traders at Manhattan and the first colonists that sailed up the James River gazed upon virgin forests that extended unbroken, as far as the eye could see. And the early explorers who sailed their picturesque craft up and down the coast of the new wonderland noted that these forests extended, practically without a break, from Florida to Maine. Little, however, did they dream that this line of timber was but the fringe of a mighty forest that reached inland, in an unbroken sweep, for over 1,500 miles. We know today (see map on page 231) that the eastern half of the new continent was then clothed with over 680,000,000 acres of forest growth, in which was to be found, in great variety, those species of woods which man has found most useful, if not indispensable, for his daily activities and well-being.



Courtesy of "American Forests and Forest Life"

THE LORDLY REDWOODS

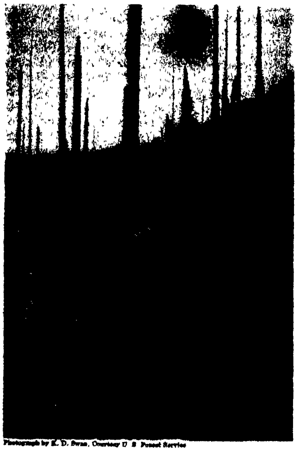
"Only God can make a tree!" It took thousands of years to make the giant trees of the west

Similarly, the first adventurous voyagers who skirted the western coasts of the American continent found that, for over 1,000 miles, there was a growth of softwood timber which, in the size and quality of its trees, was unmatched elsewhere in the world.

A "Gold Mine" of Untold Wealth

The earliest voyagers came in quest of a sea passage to the Indies with their fabled wealth of gold. Though they knew it not at the time, they had found gold, not, it is true, in the form of the glittering nugget, but in these stupendous forests of the New World. For here was "a gold mine" indeed, whose riches were to make possible the early development of a mighty people who, within a brief stretch of history, were destined to take their place in the front rank of the nations of the world.

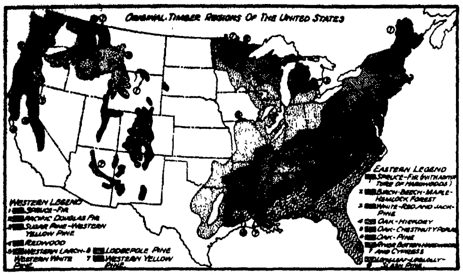
But what has become of these forests? In the east, alas! except for an occasional woodlot on the farms, not an untouched acre is left of over 600 millions of acres of those virgin forests—as any traveler between the Atlantic Seaboard and the Mississippi can see for himself. They have been all but wiped out. Of the original 681,000,000 acres of virgin hardwood and pine forests in the east, only 60,700,000 acres remain. Of the 140,800,000 virgin softwood forests of the western and Pacific States, only 77,400,000 acres remain. In other words, about five-sixths of the virgin forests of the United States no longer exist.



Photograph by K. D. Swan, Courtesy U. S. Forest Service

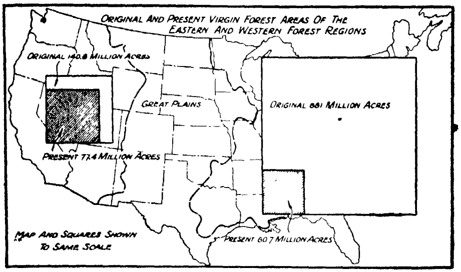
REPAIRING THE HAVOC

Planting crew of the Forest Service setting out seedlings on burnt-over forest land, St. Joe, Idaho


Original Timber Regions Of The United States
Western Legend
1 Spruce-Fir
Pacific Douglas Fir
Sugar Pine-Western Yellow Pine
4 Redwood
Western Larch-& Western White Pine
Lodgepole Pine
7 Western Yellow Pine
Eastern Legend
Spruce-Fir (with admixture of hardwoods)
2 Birch-Beech-Maple-Hemlock Forest
3 White-Red and Jack-Pine
4 Oak-Hickory
Oak-Chestnut-Poplar
Oak-Pine
River Bottom Hardwoods and Cypress
Longleaf-Loblolly-Slash Pine

OUR FORESTS AS THE PILGRIM FATHERS FOUND THEM

Three centuries ago the Plymouth and Jamestown settlers found 681,000,000 acres of virgin forest in the east. There were 140,800,000 acres, also untouched, in the west


Original And Present Virgin Forest Areas Of The Eastern And Western Forest Regions
Original 140.8 Million Acres
Great Plains
Original 681 Million Acres
Present 77.4 Million Acres
Map And Squares Shown To Same Scale
Present 60.7 Million Acres

WHAT IS LEFT OF OUR RICH FOREST PATRIMONY

Pioneer clearing for farmsteads, timber for homes, barns, fencing and firewood, the demands of industry, wasteful lumbering, decay and forest fires, have done their work

Several causes have contributed to this disaster. In the first place, the pioneer was, perforce, under the necessity of clearing the land if he was to have a home and a farm. That was unavoidable. Then, as the country grew in population, timber was required for house building, farm fencing, et cetera, and with the advent of the railroad and the development of manufacture, the professional lumberman organized his forces and, with never a thought for the future, cut down the forests with unbelievable wastefulness, selecting only the best trees and leaving behind him a tangled desolation. To the spoliation of the lumberman's axe was added, moreover, the scourge of insect pests—a source of loss which grew in range and rapidity as intercourse with other parts of the world brought in alien pests that were not indigenous. Finally there was the scourge of forest fires which, once started, would blast their way for hundreds of miles, wiping out vast areas of valuable timber lands, at a loss which has reached $25,000,000 in a single year.

Present Condition of Our Forests

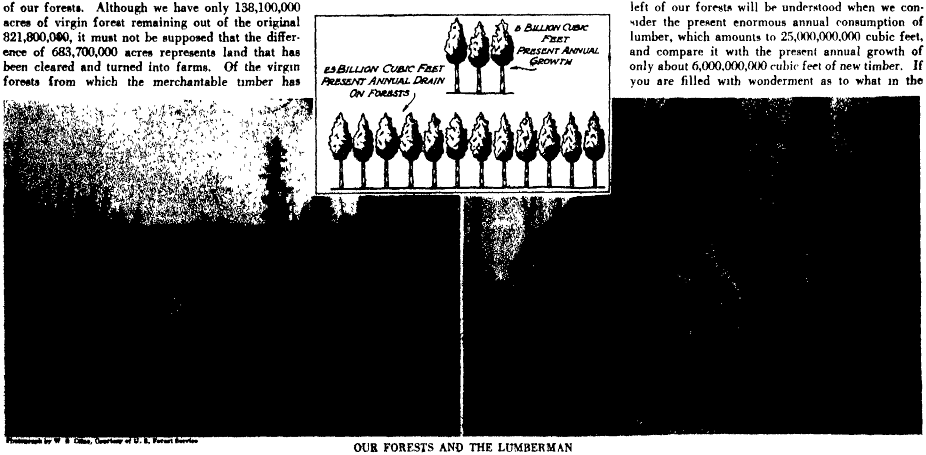
Let us now look more closely into the condition of our forests. Although we have only 138,100,000 acres of virgin forest remaining out of the original 821,800,000, it must not be supposed that the difference of 683,700,000 acres represents land that has been cleared and turned into farms. Of the virgin forests from which the merchantable timber has been removed, there are 250,000,000 acres that are more or less covered with a growth of young trees, which have been self-planted, but which are too small to have any commercial value. These great areas of cut-over forests have been left to themselves and are liable to be swept at any time by forest fires, as indeed they frequently are. In addition to this, there are 81,000,000 acres from which the forests have been removed, and whose soil is such that the land is entirely barren and unproductive of anything whatsoever. With the forest growth removed, especially where the ground is steep, there is a rapid run-off of the rainfall with a consequent washing away of the soil. On many such tracts of land, the surface soil has largely disappeared. Where this has occurred, the moisture is no longer held back and permitted to find its way gradually to the streams and rivers; but its descent is so rapid and uncontrollable that sudden and disastrous floods frequently occur.

There is another serious condition resulting from forest depletion which is too often forgotten—namely, that the great industrial states of the northeast and the central and lake states are now far removed from the remaining sources of timber supply. Although these industrial states consumed forty-five percent of our lumber in 1920, they had to depend upon the railroads to bring in the needed timber from these far-distant centers in the extreme south and the extreme west. The average haul for southern lumber is 1,200 miles and for the lumber from the northwest, it is 2,750 miles. In these days of high freights, the cost of merely hauling this lumber runs into many hundreds of millions of dollars, the estimated cost of haulage last year being the enormous sum of $265,000,000.

We shall be the more deeply impressed with the uneconomical conditions to which the country has been brought by its spendthrift policy, or lack of policy, when it is stated that seventy-five percent of the virgin untouched forests of the country and sixty percent of all the forests, both virgin and natural second growth, are to be found in the remote Rocky Mountains and upon the Pacific Coast, and therefore far from our great industrial centers.

How Timber Is Consumed

The threat of the absolute wiping out of what is left of our forests will be understood when we consider the present enormous annual consumption of lumber, which amounts to 25,000,000,000 cubic feet, and compare it with the present annual growth of only about 6,000,000,000 cubic feet of new timber. If you are filled with wonderment as to what in the


6 Billion Cubic Feet Present Annual Growth
25 Billion Cubic Feet Present Annual Drain On Forests

Photograph by W. B. [illegible], Courtesy of U. S. Forest Service

OUR FORESTS AND THE LUMBERMAN

Left: *Railroad ties cut from National Forest timber, stamped "U. S." by Forest officers, and charged at so much per tie.* **Center:** *For every tree grown, four are cut down.* **Right:** *The drain on our forests is 25 billion cubic feet per year. Most of this is necessary, but there is much needless waste* world we are doing with all this lumber, consider the following facts:

To supply us with telegraph and telephone poles, some 5,000,000 trees have to be cut every year. The Forestry Department estimates that our farmers use about 5,000,000 fence posts per year. The miner and the excavator dispose of 260,000,000 cubic feet of wood every year, and our railroad system in every twelve months places 130,000,000 new wood ties under the rails. The cooperage industry calls for 250,000,000 cubic feet. The lead pencil in your hand is a small article, but remember that 1,000,000,000 of them are used up every year. Finally, there is the enormous and growing demand for wood pulp for paper.

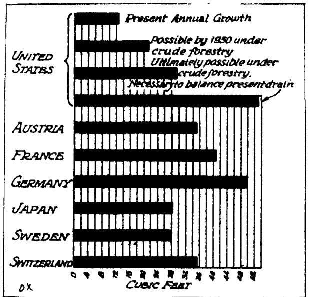
When you take up your 40-page daily paper, and realize that yours is but one of many millions printed that day, have you ever wondered where in the world the material comes from to produce this avalanche of reading matter? Of course you have. But how many of you realize that the material of your daily paper is wood pulp and that to keep up this enormous output, our soft-wood forests are being swept away. If you doubt it, let me refer you to the Forest Service which tells us that, in 1922, we consumed more than 8,000,000 tons of paper of all kinds, or more than all the other countries of the world combined. To make this total, 5,847,000 tons of wood pulp were required, and in making the pulp, 9,148,000 cords of wood were used up—and a cord, mind you, is a pile of wood four feet high, four feet wide and eight feet long.

Such is the present situation. What are we going to do about it?

We Must Become Growers

The answer to that question carries us back to the very beginnings of the nation when, here and there, a few far-seeing men found time to think about the future. Thus, we have William Penn's requirement that one acre of forest be left for every five cleared; and the ordinance of Connecticut, that lumber should not be taken out of the township. In 1799, Congress appropriated $200,000 for the purchase of a forest reserve containing lumber suitable for shipbuilding. Again, in 1827, our forefathers made an attempt to grow live oak for the same purpose. Then, gradually, the individual states began to think in terms of timber conservation until, in 1873, Congress passed the Timber Culture Act, which gave to any settler 160 acres if he would plant and maintain forty acres of timber in treeless sections.

The beginning of the present movement to conserve our forest dates from 1886, when the Division of Forestry was created. Commencing with a pitifully small appropriation of $30,000 or less, the work expanded until in 1901 the Division became the Bureau of Forestry. In 1905, the Bureau, in its turn, became what is now known as the Forest Service, whose appropriation for the year 1924 was $12,731,869.



DEATH KNELL IN A DIAGRAM

This diagram proves we shall soon have no forests left. Income, 12 cubic feet, outgo, 52 cubic feet, spells bankruptcy. Europe grows as much as she cuts

Hitherto, we have been a nation of woodcutters; henceforth, thanks to national legislation and our highly efficient Forest Service, we are learning to become a nation of wood growers. Only in this way can we avert disaster. European peoples have been nations of wood growers for centuries. Most carefully do they tend their forests, most scientifically do they cut the mature wood and plant the seedlings or young shrubs. To be convinced of this, look at the accompanying diagram. Under our present methods, our forests produce only 12.8 cubic feet per acre whereas, to meet our present consumption, they should produce over 52 cubic feet. European nations on the other hand, because of centuries of careful forestry, are growing as much timber as they cut, Austria and Switzerland producing nearly 36 cubic feet per acre, France, 40.5 cubic feet and Germany, 48 cubic feet per acre, per year.

Oh yes, the thing can be done if we will but cease to play the spendthrift and practice a little of the virtues of thrift.

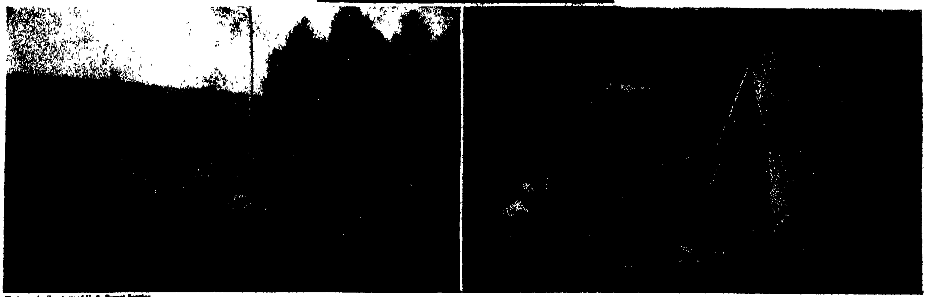
But wise legislation and the fine work of our Forest Service are stemming the flood of extravagance. Already the Government has set aside 149 national forests, containing over 156,000,000 acres, which it administers under the most up-to-date principles of forestry. Under what are known as the Weeks Law and the McNeary-Clarke Forestry Bill, provision is made for the purchase of additional forest lands, for federal co-operation with the states in fire protection, and for forest activities designed to promote forest growth.

Of the activities of the Forest Service, it is hardly necessary to speak at any great length; for in previous issues we have made them familiar, particularly in the article on forest fires which was published in our issue of July, 1925. Forest fires have been the greatest source of loss, some 2,000,000 cubic feet having been wiped out in a single year. Forest rangers, of which there are 4,000 in the western forests, alone, are a selected body of men especially trained for their job. A close watch is maintained from lofty lookout points, and from patrolling airplanes. So strict is this watch that an incipient fire is quickly detected. A telephone call suffices to assemble trained bodies of fire fighters at the danger point.

A Job of Vast Magnitude

Equal in value to the preventive work of the Forest Service is its constructive work in cleaning up and replanting the millions of acres which have already been devastated by fire and by the axe of the lumberman.

Before we shall learn to become a nation of wood growers, the present widespread campaign of education must be intensified. Thanks to the Forest Service and the several patriotic societies which are at work, every citizen of the United States who can read or appreciate the meaning of a photograph must, by this time, be more or less familiar with this great national problem of forest conservation. But the good work has only begun. There are fourteen states that have no organized forestry. The Federal appropriations are meager in comparison with the magnitude of the work. There is still a big job to be done. This job must be done in a big way.



Photographs Courtesy of U. S. Forest Service

THE FOREST RANGER—FAITHFUL GUARDIAN OF OUR FORESTS

Left: *Grazing on Forest Reserves is regulated and a fee charged. Forest officers counting sheep as they enter Reserve.* **Center:** *Mounted Forest Ranger looking for forest fires.* **Right:** *Tent pitched, horses turned loose, the Ranger cooks his supper*

A New Maya Discovery in Mexico

A Remarkable Find that May Alter Our Interpretation of Maya Indian History, and Set a Closer Date to the Founding of the New Empire of the Mayas

By Thomas Gann
Fellow of the Royal Geographical Society
Fellow of the Royal Anthropological Institute

Much Yet to Learn

We still know comparatively little about the Mayan hieroglyphs, except the numbers, dates and a few other things. No key like the famous Rosetta Stone, bearing identical inscriptions in both a known and an unknown tongue, has yet been found. Thus our knowledge of the hieroglyphs is still confined practically to the identification of the numbers, the day and month signs, and some less important symbols.

An "initial series" is a reckoning which is carried back to a supposed beginning date, long before any recorded dates.

THE stela shown in the accompanying photographs was discovered by me on January 6, 1926, on the east coast of the Chetumal Bay, in Quintana Roo, Yucatan, while searching for Maya ruins along the coasts of the bay. These coasts are completely covered with forest down to the seashore, and with the exception of a few huts of Maya fishermen, they are entirely uninhabited.

The stela consisted of a block of shale nine feet long, eighteen inches broad, and twelve inches thick. Most fortunately it had fallen upon the side bearing the Initial Series, which had consequently been protected from the weather, and was found to be in a remarkably good state of preservation.

October 26, 333 A.D.

The first glyph, which owing to the slope of the stone does not show well in the photographs, is undoubtedly the Initial Series introducing glyph, the superfix, *katun* sign, and trinal subfix being easily identified.

The second glyph is the face variant for the *Bactun*, showing the hand in place of a lower jaw. The numerical coefficient of this glyph shows half a bar and two dots, the upper half of the bar and the upper two dots having been broken away. It was unmistakably 9.

The third glyph is very clearly the face variant of the *katun* sign, with the numerical coefficient 8—a bar and three dots.

The fourth is the face variant for the *Tun*, with fleshless lower jaw, and numerical coefficient zero.

The fifth, the *Uinal* sign, like the full figure glyphs at Quirigua, exhibits the entire body of the frog, with projecting feet, the zero sign placed in front of the face. The *Kin* sign is badly damaged, but its coefficient zero is unmistakable. Then follows the day 5 *Ahau*, and immediately beneath this, the month 3 *Chen*.

The complete Initial Series reads 9 8. 0. 0. 0., 5 *Ahau*, 3 *Chen*, corresponding in Spinden's Correlation to the date 26th of October, 333 A D

This discovery is the fourth Initial Series date ever found in the whole peninsula of Yucatan, and if it is a contemporaneous date, as it appears to be, it is 11½ *katuns*, or nearly three centuries earlier than the next earliest date known in this region The latter date was found at the great ruined City of Chichen Itza, and is 10 2 10 0 0

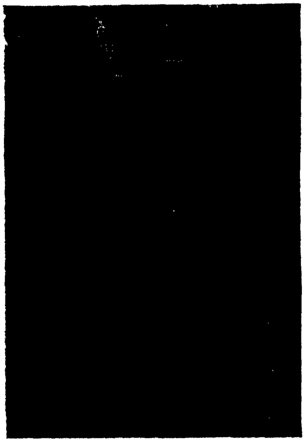
This remarkable find would, in fact, appear to indicate that the Maya people occupied the south of Yucatan centuries before they were supposed to have deserted their southern cities of the Old Empire, and thus it may necessitate a complete revision of our present ideas as to their migration into Yucatan, and the founding at that time of their New Empire.

Mystery

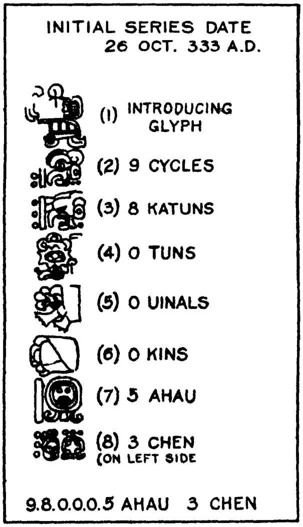
The stela stands a few yards to the east of the central one of three vast, stone-faced, terraced pyramids, which are contained within a great semicircular wall or fortification, with an arc of about one and one-half miles formed by the sea coast The height of this wall varies from three or four feet, where it has fallen, to twelve feet where it is intact This reminds one strongly of the fortified cities of Tuluum and Mayapan, the former on the coast, the latter in the interior of Yucatan.

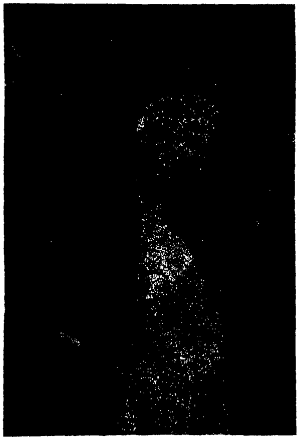
The whole site is covered with dense bush, but further exploration here is urgently called for in order to elucidate the mystery of this truly incomprehensible date.

The region must at one time have been densely populated, as it is simply teeming with such small objects such as potsherds, clay beads, and heads, both animal and human, Malacates, obsidian knives, flint chips and javelin heads, and so on These are to be found everywhere lying on the surface of the ground when it has been cleared of bush and undergrowth.

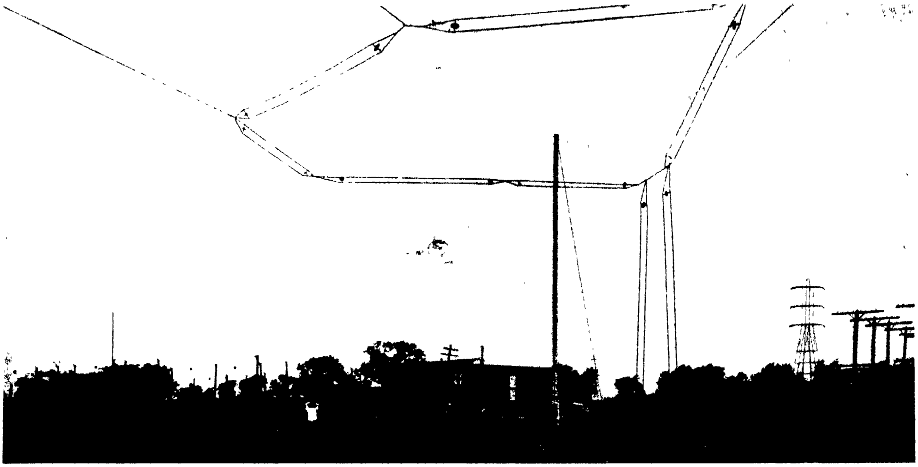


UNKNOWN GLYPHS AT BASE OF STELA
Some day it is hoped that a clue which will enable all the glyphs to be deciphered will be found





DR GANN AND HIS NEW STELA
A stela is an upright slab or pillar, bearing inscriptions This one has fallen down



AERIAL FOR RADIATING CORKSCREW WAVES

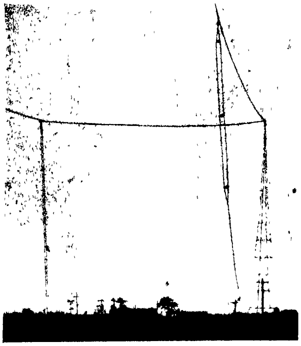
This horizontal series tuned loop aerial emits horizontally polarized radiation in all directions The waves are projected at a high angle upward and thus this type of aerial is classified as a "high-angle radiator" High angle radiation is useful in covering long distances

Shooting Radio Concerts Into the Sky

Experiments with a New Type of Wave, Which Twists in Space Like a Corkscrew

By Orrin E. Dunlap, Jr.

WHEN Paris was bombarded by the Germans during the World War a long-range gun was used which shot projectiles high into the upper atmosphere and over a distance of 75 miles The rarefied air offered less resistance to the shells than the atmosphere offered near the surface of the earth.



PART OF WGY'S AERIAL SYSTEM

At the left is a horizontal doublet suspended between two 300 foot masts Two transmission lines, separated by insulators lead from the broadcasting apparatus one line to each half of the doublet The two sections of the horizontal doublet are insulated from one another. At the right is a six wire vertical cage aerial

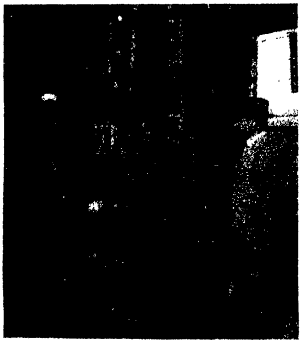
Since the war, radio engineers have discovered that if they project Hertzian waves into the rarefied regions they will carry much further than if they are sent out parallel to the earth's surface. Furthermore, the waves in the upper air seem to twist in their plane because of an influence produced by the earth's magnetism This is one explanation of the reason why short waves spin long distances, but skip over the area surrounding the transmitter. In some cases the signals are not audible within a radius of 500 miles of the sending station but 3,000 miles away they are very loud. This is known as the "jump over" effect.

The short-wave aerial that KDKA, Pittsburgh, employs for broadcasting to Africa and South America is a straight, vertical rod, designed to shoot the waves high into the sky, giving them high angle of radiation This type of antenna gives almost complete vertical polarization of the waves.

May Account for Fading

A polarized wave is one which vibrates only in one direction A water wave is polarized because it vibrates in only one direction—up-and-down. It is believed that as long as a wave hugs the surface of the earth it will maintain its up-and-down motion, similarly to an ocean wave, because of an anchorage effect the globe seems to have, but if the wave is radiated into the upper regions, it will twist in corkscrew fashion as it moves.

This new method of transmission has introduced another theory to account for fading and "dead spots" in the ether. It is apparent that the earth's magnetism slowly twists a horizontally polarized wave's plane and that the various twists affect antennas differently. For example, the wave of a New York station might not be twisted just right to give up much energy by the time it reached Syracuse, but ten miles further on, the twist would be more favorable for antennas to intercept energy.



A SHORT-WAVE EXPERIMENTAL STATION

So sensitive is this equipment to body capacity that the apparatus is housed within a cage and tuning is done by means of a wooden rod Dr E F W Alexanderson, who is devoting much of his time to short wave experiments, is at the right. The 41-meter signals have been heard in Egypt and other countries far distant from Schenectady

Therefore, Syracuse might be termed a "dead" area as far as the particular transmitter is concerned.

When waves are radiated horizontally along the earth's crust they are subject to absorption by trees, steel structures, wires and mountains which contain metallic deposits. These influences reduce the transmitter's range and decrease signal strength. In order to conquer the vagaries of the ether it seems reasonable to believe that fading could be minimized, "dead spots" penetrated, and louder signal intensity made possible if a broadcaster could be made to radiate two types of waves—vertical and horizontal—so that the receiver could benefit by the combined effect, or at least be certain of detecting one of the waves, although the other might fade.

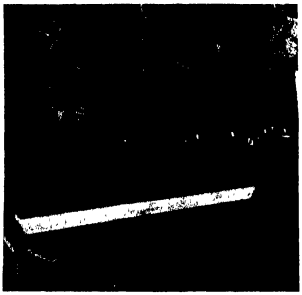
Dr. E. F. W. Alexanderson, in his laboratory at Schenectady, New York, is conducting experiments with horizontally polarized waves. He broadcasts vertical and horizontal waves, so that as the two waves travel away from the aerial their combined strength and individual characteristics aid in overcoming the ill effects which are detrimental to reliable radio reception.

To produce the horizontally polarized waves, Dr. Alexanderson employs a loop aerial, consisting of six, tuned units suspended in a horizontal direction, so that it will radiate a wave polarized in the plane of the loop. As these waves get further from their source, they twist in their plane and observations indicate that they first turn when they are ten to fifteen miles from the transmitter.

Stations May Use Several Wavelengths

Dr. Alexanderson says, "We have found that the space wave from a 50-meter station twists in its plane of polarization about 20 to 30 degrees in ten miles. From this we may conclude that it would acquire a twist of 180 degrees in 60 to 80 miles. It is therefore reasonable to assume that a space wave emitted from a broadcast station would acquire a twist of 180 degrees in 100 miles. The earth-bound wave, on the other hand, proceeding from the same station will maintain its vertical plane of polarization, due to the proximity and guidance of the earth. The earth wave and space wave may thus arrive 180 degrees out of phase and cancel each other.

"If all conditions were constant we would thus have a permanent 'dead spot' of reception such as is sometimes observed. Variations of the conditions which control polarization will, however, cause the signal to fade intermittently. From this reasoning it might be expected that these phenomena would repeat themselves at a distance of 300 miles from the station where the plane has twisted another 360 degrees. At that distance, however, the earth bound wave has been so largely absorbed that it is of a lower order of magnitude than the space wave and therefore cannot produce interference. Much will undoubtedly become known in the next few years which will enable us to predetermine more accurately the phenomena of shifting-wave polarization and fading."



HOW RADIO WAVES TWIST IN THEIR PLANE

Twenty two weights, arranged in a row and joined together by rubber bands are used to illustrate the polarized wave theory. Each weight is suspended from a yoke and an equal weight is hung from the other side as a counter balance but shielded from view to avoid confusion in observing the wave motion, which is in a corkscrew fashion. This device was set up in the General Electric Laboratory

Some believe that when more is learned about horizontally polarized waves, the broadcasting stations will not use only one aerial, or one wavelength, but will adjust their transmitters to send out a certain wave for different hours in order to cope with the varying conditions caused by daylight and darkness.

Analysis of reports from broadcast listeners on comparative tests of horizontal and vertical radiation from a 30 kilowatt plant of WGY, indicate that the horizontal radiation gives better service in the zone from 60 to 250 miles from Schenectady, but at greater distances the vertical aerial radiation is more satisfactory. The letters testified that there is no enormous difference in the loudness of the signals produced by the two types of transmission. This seems to indicate that waves may leave an aerial vibrating in either a horizontal or a vertical plane and will then be twisted around until they give practically the same effects. It has been found that at a distance of about ten miles from a horizontal loop radiator, the wave comes down with an almost vertical direction of propagation. For those who believe in the Heaviside surface layer, Dr. Alexanderson points out that this seems to be good evidence that waves radiated high into the sky are reflected directly back to the earth when they strike the ionized region in the upper atmosphere.

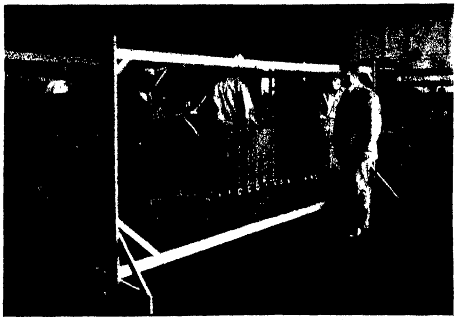
So successful have been the tests at Schenectady that the Radio Corporation of America has decided to build a chain of short wave stations to link the islands of the Pacific with the mainland. These stations will have aerial systems classified as short-wave, high angle radiators. Already six short-wave transmitters, installed in a temporary manner, are supplementing commercial long wave stations. Signals on wavelengths between 15 and 30 meters have performed good service across the Atlantic during daylight hours. The best all around service seems to be about 40 meters. Conditions for wave propagation across the Pacific are superior to those over the Atlantic and for that reason it is expected that a reliable short wave service will be established between California and the Orient. Experiments will be conducted to determine which wavelengths are best suited for transpacific communication.

Comparative Tests Now Being Made

The experimental station, built near Schenectady by the General Electric Company for the purpose of exploring polarized and short waves, is capable of operating with seven transmitters simultaneously on different wavelengths and with different types of aerials. Observations of these transmissions are made all over the world. The object of these tests is partly to explore the propagation characteristics of different wavelengths and to make final tests of comparison between the various types of aerials. Three types of radiators are used in these experiments but they are the result of a sifting process conducted on a smaller scale in which many other aerials have been tested and temporarily discarded. The radiators now in use are: The straight, vertical aerial oscillating at a hermonic frequency; the horizontal aerial with an over-all dimension of one half wave, fed in the middle through a transmission line and, third, the series tuned, horizontal loop. All these radiators have one feature in common—they shoot the waves high into the sky.

APPARATUS FOR TESTING RADIO WAVE THEORIES

The 50-kilowatt plant of WGY, Schenectady. At the right is a 5 kilowatt transmitter used with the high-powered set for comparative tests. This experimental station has seven transmitters and various types of aerials for simultaneous exploration on different wavelengths



DEVICE FOR STUDYING CORKSCREW WAVES

This mechanical model has been set up by Dr. E. F. W. Alexanderson for studying wave motion in the horizontal and vertical planes. It shows that if a wave is started in a plane of 45 degrees between the vertical and horizontal planes it assumes the shape of a corkscrew

Diving Through Mud to Rock

By Frank W. Skinner

FOR many years the material excavated from cellars, grading and subways, sewer and water trenches and the like—millions of cubic yards of earth and rock—has been used to fill in low and wet ground. This filling-in process, together with the natural movement of sand by the waves, has built out the shores of New York Bay and the North River until the shore line is now blocks farther out than it was formerly, and whole streets have been built on the made land.

This reclaimed area is so immensely valuable that wherever the bearing value of the surface is inadequate to carry a lofty skyscraper, engineers do not hesitate to incur the heavy expense of carrying the foundations down to the underlying rock. The loads are often vastly increased by wind pressure, vibrations and other special stresses—conditions that would soon completely wreck a tall, heavy building, just as surely as would a violent earthquake, if the foundations of the building were not absolutely enduring and unyielding.

DAVID AND GOLIATH

Huge orange peel dredge, capacity five cubic yards, with (beneath it) a miniature hand operated dredge

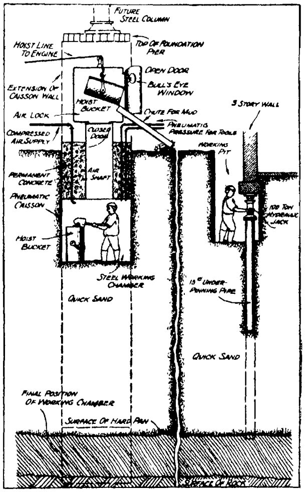
The sixteen-story Evening Post Building, at West and Carlisle Streets, New York City, will contain immense quantities of heavy machinery and materials, including enormous printing presses, whose continual operation must cause vibrations requiring the most substantial and immovable foundations to transfer them safely to the deep underlying bed rock. Here, hundreds of feet beyond the original shore line, above long-forgotten docks and piers, sunken wrecks, stone, timber and debris buried under many feet of mud and earth and sediment, there is, 20 feet below the surface, a vast bed of quicksand, 30 feet thick. This bed of quicksand covers a hard, irregular crust perhaps 10 feet thick over the bed rock, to which the foundation loads must be safely carried. An inexhaustible flow of water through the loose sand makes impossible the digging of deep open pits, and the depth and the large quantities of debris obstructing the soil prevent pile driving.

Nothing daunted, the engineers, architects and contractors determined to sink their eighty-six great foundation piers to everlasting security on the living rock, or on well proved hardpan overlying it. This they did by means of great diving bells that gradually burrowed their way down from the surface, as the tall concrete shafts were built on their roofs. The shafts were always maintained above the surface of the ground. They were filled solid with a concrete that will grow stronger and stronger year by year.

The stone foundations of old light buildings and about 2,500 yards of earth and debris were removed by a steam shovel that dug a pit about nine feet deep down to ground water level, in which were erected groups of small wooden towers. On these were installed four great derricks, with 50- and 60-foot booms, capable of reaching to every corner of the lot and of handling ten-ton loads from the streets. Eighty-six steel pneumatic caissons, about 8 feet high and from 5 to 16 feet in diameter or length, according to whether they were round or square, were used. These bottomless, air-tight boxes were the diving bells in which men, the "sand hogs," worked under an air pressure which was sometimes twice as great as that of the free atmosphere.

How the Caissons Were Sunk

The derrick booms, operated by electrically driven hoisting engines, always ready for instant, silent work, swiftly swung the heavy steel caissons to exact position. The sand hogs entered, dug up the bottom and loaded it into buckets. The buckets were hoisted out through chimney-like, vertical steel shafts, surmounted by chambers called air locks, with double doors, one of which was always closed to prevent loss of air pressure. The bottom was undermined so that the caissons sank, a few inches an hour, safely and steadily, through the treacherous quicksand and flowing water that could not rise up in the open bottom because it was constantly pushed back by the compressed air that filled the chamber.



SINKING A CAISSON TO ROCK

At left, foundation cylinder is being sunk to rock. At right, sinking underpinning pipe below wall of building

As each successive caisson sank, hundreds of tons of plastic concrete, deposited on its flat roof, forced it down and built up the great permanent foundation pier, containing a temporary narrow well or shaft for the passage of men and materials to and from the working chamber of the caisson.

Huge electrically driven air pumps supplied air to force the ground water out of the caissons, and another powerful compressor furnished a constant supply of high-pressure air to operate pneumatic tools used in cutting timber, drilling the rock, and spading hard materials in the working chambers.

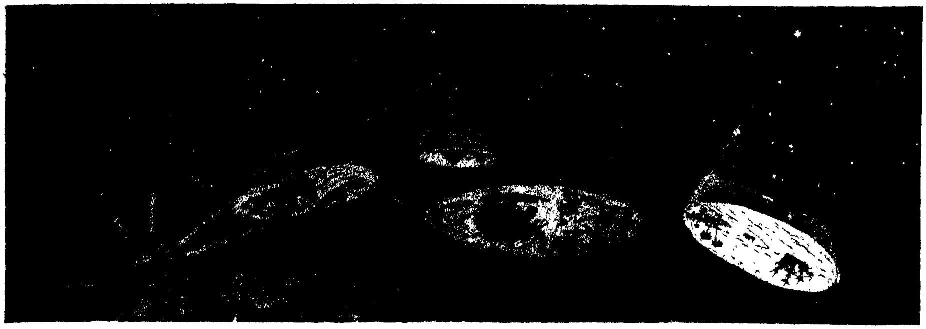
Some of the caissons were sunk so close to a neighboring three-story brick building that there was possibility of undermining its shallow foundations, a danger that was averted by first supporting its adjacent wall on a row of steel and concrete columns built under it and carrying its weight securely down to the hardpan or rock independent of any movement of the treacherous sand on which it rested.

Pits just big enough for two men to work in were dug close to the wall and carried down a few feet below the old foundations and under their full width. In each pit a six-foot vertical length of 15-inch heavy steel pipe was set. A 100-ton hydraulic jack was set between the top of the pipe and the bottom of the old foundation, and operated to bear against the latter and force the pipe down into the sand. Another section of pipe was connected to the first and jacked down, and so on, the soil inside the pipe being excavated simultaneously by a miniature hand operated, orange peel dredging bucket. The bucket, although holding only about two quarts of sand, could grip firmly enough to bring up rocks as big as a man's head—rocks so large that they could barely pass through the pipe. When the pipe was driven to the rock or hardpan, thoroughly cleaned, examined, tested and subjected to a load of more than 80 tons, the jack and bucket were removed to the next pipe and this one was filled with concrete wedged firmly against the old foundation and its top enclosed in a solid block of concrete.

PREPARING FOUNDATIONS FOR SKYSCRAPER

Pneumatic caisson being sunk. Note "sand hog" entering the airlock through which excavated material is removed

With a maximum force of about 200 men in the three day-and-night shifts, the foundations were completed in about 114 calendar days after starting the first caisson.



The Super-Telescope

A Scientific Fantasy of the Past and the Future

By M. Luckiesh

Director, Lighting Research Laboratory, National Lamp Works of the General Electric Company

IMAGINE a super-telescope which would not only penetrate for our eyes the remotest confines of the universe but would turn back the pages of history Heretofore, improvements in telescopes have merely pushed back the veil further and further. The unaided eye can see only about 3,000 stars from one viewpoint Galileo with his small telescope, possessing an objective lens two and one-quarter inches in diameter, multiplied the number of visible stars a hundred fold The large telescopes of the present time have multiplied the number of visible stars a hundred thousand fold

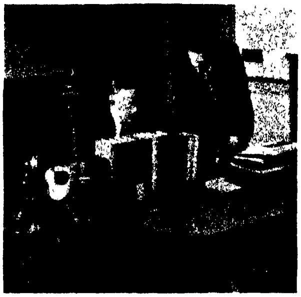
But why be satisfied with just seeing celestial bodies and their details? Why not imagine the super-telescope which would give us a view of the past history of the earth at any page we desire, one that would provide us with a motion picture of the ages? Such a super-telescope appears possible and even probable.

Can We Amplify Light Images?

Today, telescopes depend for their magnification solely upon optical means. But those of us who are familiar with scientific phenomena learn to think in terms of electrical magnification as the method of almost infinite magnifying possibilities. When we desire to detect something very small, and if we are able to make one of the steps in the process electrical, the range of the apparatus is likely to be very great. Radio as known to most of us is proof of this point. Then why not imagine that some day the telescope will have its magnifying power enormously increased by the introduction of a link consisting of electrical magnification? Surely this is plausible possible, and perhaps probable

Having such an instrument, what shall we do with it? The nature of the so-called "canals" on Mars would be settled. Next, we might search the remote regions for other galaxies. This would indeed be wonderful but would it compare with seeing our own past ages in actual motion pictures?

What would compare with the thrill of witnessing Caesar leading his legions into battle or Cleopatra in royal splendor upon the Nile? What thrills there would be in viewing the *unwritten* pages of our history—our earliest human ancestors in their pursuits or the huge reptiles of the bygone ages in deadly combat? As we sat upon Pike's Peak with this super telescope, how marvelous it would be if we could see the Rocky Mountains actually being formed! Perhaps we should not be so ambitious as to extend our view back as far as such geological epochs. At least, let us see how this might be accomplished



DR LUCKIESH IN HIS STUDY

He is best known as the author of "The Foundations of the Universe" a semi-popular scientific treatise

Having this super-telescope with its enormous magnifying power, we merely take advantage of the finite velocity of light. Of course, to most of us light seems to travel from one place to another instantly, because its velocity (186,000 miles per second) is so great Nevertheless when viewed in terms of stellar distances, light travels relatively slowly. It takes it eight minutes to come from the sun to us. In other words, we see events on the sun eight minutes after they have occurred. A collision of two remote celestial bodies which resulted in a sudden creation of light would be a wonderful scene As we watched through this telescope we would not see the light travel through space but we would see dark bodies suddenly become luminous by this light, one after another as their distances were greater and greater from the new source of light.

If we searched the celestial bodies near the earth for a minute mirror—a facet of a crystal or a plane surface of *molten material*—we could see ourselves in that mirror if it were properly oriented (and if we waited long enough) By means of other minute mirrors oriented at slightly different angles we could see other parts of the earth If we viewed a mirror surface on Polaris or a body about equi-distant we would see events which actually took place there 75 years ago because it takes light 75 years to reach us from such a distance

Seeing Past Events in the Future

By choosing the proper mirror we could witness, by reflection, events which took place on our earth 150 years ago If we could do this now we might see the Revolutionary War beginning, we might see battles actually being fought which are now famous in our history Rigel is 466 light years away If we could sit on that star with our electrical telescope, we would have to wait 33 years before we could see Columbus with his tiny ships approaching the shores of this country for the first time From a mirror as far away as the small Magellan cloud we would see far into and perhaps beyond the Old Stone Age Recent measurements indicate that certain celestial bodies are a million light years away In a mirror on one of these, earth events which took place two million years ago might be witnessed

All this appears possible barring adverse atmospheric conditions At least these paragraphs give us a vivid picture of the finiteness of the velocity of light They stimulate the imagination and help us to gain an idea of stellar distances and their relation to time in terms of earth events When thought of in terms of electrical magnification, this super-telescope appears to be a scientific possibility

Who can say that our children, or even some of us, may not witness the great motion-picture of the ages? Written history may then have its gaps filled and its errors corrected But better still, future human beings may see the happenings with their own eyes and the countless centuries of unwritten history which have heretofore been concealed from human eyes, may be revealed

Photographs made especially for the Scientific American by Thomas C. Turner

A Typical Trout Stream. Trout Swim Upstream, Jumping the Rapids, as Spawning Time Approaches

Down On the Fish Farm

Whether You Catch Him in the Brook or Order Him at the Hotel, Your Trout's First Home Was the Hatchery

By Milton Wright

ON the platter the waiter set down before us reposed a broiled trout. Nestling against its festoon of parsley it glistened with the golden melted butter running down its sides. We slipped our knife under the skin to lay bare the firm white meat, visioning as we did so the hip booted angler in some mountain brook casting his bright colored fly to lure this morsel to our table.

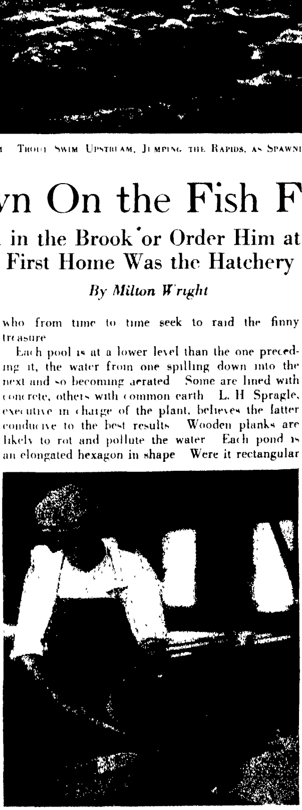
Then, imbedded in the fish's tail we saw a small metal tag with the letters "NYSCCO" and our picture of the fisherman vanished. This brook trout had never seen a brook.

The Complete Hatchery

Back of that metal tag lies not a fisherman's adventure, but another story, the story of an important and growing industry. To get that story the writer and the photographer sought a typical fish hatchery. Such a one they found in Paradise Valley up in the Pocono Mountains. It was ideally suited to their purposes, for it not only was the largest commercial institution of its kind in the country, but it was complete, supplying hotels, restaurants and markets with trout for food, furnishing fish eggs to most of the state conservation commissions and selling small trout to wealthy sportsmen and fishing clubs to stock their streams.

As with every hatchery the water supply is all important. Preferably it should be spring water free from limestone. Here are ten mountain springs bubbling up water incredibly soft, all converging into one rapidly flowing pool with sluices and gates to control the supply readily in the event of freshets. Below are a score of pools surrounding a long wooden hatchery building, the whole enclosed by a strong, high wire fence to keep out the poachers who from time to time seek to raid the finny treasure.

Each pool is at a lower level than the one preceding it, the water from one spilling down into the next and so becoming aerated. Some are lined with concrete, others with common earth. L. H. Spragle, executive in charge of the plant, believes the latter conducive to the best results. Wooden planks are likely to rot and pollute the water. Each pond is an elongated hexagon in shape. Were it rectangular the water would be likely to be dormant in the corners, the current running through the center. Each pond is cleaned frequently by draining off the water and sweeping out the sediment with a broom.



STRIPPING

Eggs from the females and milt from the males are squirted into the same pan and mixed with water before fertilization takes place

Trout swim thickly about in each pool, the big fellows in one, smaller in another, still smaller in a third, and so on. If by some chance a large trout wiggles through a wicket into a pond of smaller ones, every man of the organization drops whatever he is doing and joins in the chase after that one trout. He is a cannibal and if he should be left undisturbed there soon would be none of the little trout left. If necessary, they shoot him.

Two Years in the Pools

As the fish grow they are thinned out in order to give them more room. In sorting them, a box with brass rods for the bottom is used, very much like a box used for sorting oranges. This is shaken under the water, letting the smaller fish drop through and the larger ones remain in the box. The rods can be adjusted to let fish of any desired size slip through.

In these pools the fish are carried along until they are two years old. The water, coming out of the ground close by, is warmer than the air and never freezes over, except in the last pond, where it is so deep the trout can swim about freely far below the ice. In the spring time they are fed twice a day, in warm weather this is cut down to one meal a day and the one-time rate keeps up until the following spring. For the older fish the food consists of chopped beef hearts or sheep pluck. In some hatcheries chopped fish is used for food.

Brook trout for market are designated by their weight; those that run four to the pound are known as quarters, three to the pound as thirds, two to the

FEEDING TIME

Chopped beef hearts is thrown into the pond with a tin dipper. The trout swarm about. Note how they splash the cement wall

pound as halves. Only occasionally is a hatchery trout more than a three-quarter for the demand for larger trout both for food and stocking purposes is limited. In natural streams, of course, trout grow considerably larger. In Maine they have been caught weighing as much as twelve pounds, with four and five pounders not uncommon. It is interesting, by the way, to note that scarcely a day passes when the fishing season opens, without several fishermen who have had no luck in the brooks, coming to the hatchery to fill up their creels.

November is the spawning time. The trout are caught in nets and carried in tubs into the hatchery building, where there are two divided troughs. Into one end of a trough the fish are dumped. One man, acting as a stripper, grasps the fish, tail down, with his left hand, and rubs his right hand firmly, pressing not too hard, down the fish's belly. From the female fish, from four hundred to six hundred eggs squirt. Each cream-colored egg is about half the size of a pea. The milt from the male fish is stripped in a similar manner into the same pan. After each fish is stripped it is tossed into a trough of running water, the males into one trough, the females into another.

After handling about thirty of the three-year-old females the stripper has a quart and a half—or 15,000 to 18,000—of eggs. These eggs, together with the milt from the male fish—buck is the colloquial term for him—are then washed, spread on a screen-bottomed tray and leveled off. The dead eggs are picked out. A pair of little wooden pincers is sometimes used for this. A better method, however, is to take a small syringe, blow about until you find a dead egg, suck it in against the mouth of the syringe and blow it off to the floor or in a refuse basket. A dead egg may be recognized by its color. From a cream tint it has turned white. If it is not eliminated from the others it will contaminate them.

Washing the eggs enables them to fill up with water, a condition necessary to their fertilization by the milt they have been mixed with. Each tray is then set gently into one of the many hatching troughs that fill the building. These troughs are the incubators—the home of the embryo trout until they graduate from eggs into "fry." They must be handled as little as possible, although every other day they must be sorted over and dead ones removed. The warmer the water is the sooner they will hatch.

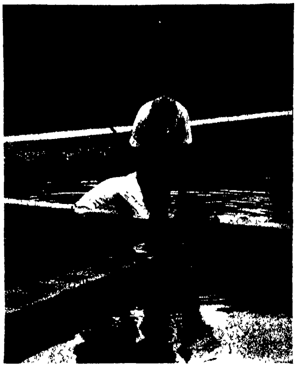
The Hatching of a Fish

In 30 to 45 days the eggs begin to "eye up." Two black spots appear, they are the eyes, the first part of the creature to show in the hatching process. Just before the appearance of the eyes there has been a change of color, the creamy tint deepening to a sort of salmon. The eyes grow stronger, the body develops and in 20 to 45 days more the eggs hatch and the tiny wisps of shell fall through the tray's mesh bottom.

Each tiny fry comes free of his shell carrying his own lunch basket. This is a sac attached to his abdomen and it holds the nourishment he absorbs as he grows. The food sac gets smaller as the trout grows larger until the sac is completely absorbed. Then the baby trout at this stage swims up to the top of the water and dives about as if looking for food. This is about 35 days after he has hatched from his shell.

His first food is beef liver. This is skinned, the sinews removed, and then run through a fine food chopper six or seven times. As the fish grow, the quantity of food is increased and is ground less fine. At first the fish are fed five times a day. This is gradually cut down to twice a day, but the quantity at each meal is considerably larger.

Until spring the fry are kept in the troughs. Then they are put in brooding pools and as they grow they are thinned out to give them more room. When they get to be the size of a man's finger they are called "fingerlings." They continue to grow and to be sorted into other pools until they reach the age of two or three years, when with the help of the stripper, it is their privilege to achieve parenthood.



SORTING TROUT

They are caught in the net and poured into a box with brass rods. The smaller ones drop through, leaving the larger ones behind

Such is the cycle of trout life at the hatchery.

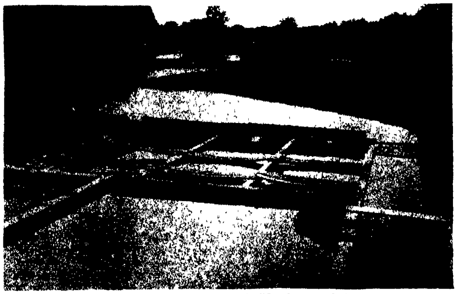
A dull, prosaic sort of business, you say? Not a bit of it. Think of the natural enemies you have to outwit. A fish hawk swoops down, snatches up a trout, plays with it as a cat plays with a mouse, drops it in a field and then goes back for another one. Last summer the hatchery entered into an alliance with a small boy who liked to shoot a gun. At 25 cents a bird he brought down 80.

Or a blue heron comes at night, and the next night invites all his relations to join him. Or a kingfisher perches atop a fence post to survey his intended catch. The thing to do with him is to set a spring trap on the post.

Or a water snake makes trouble. There was one that worked its way through a valve and held his mouth up to a wire screen and drank in the small fish as they came against it. And there are eels and robins and catbirds, but they generally are content with the dead fish. But the small green heron, the frog, the barn rat—all are creatures of prey constantly to be fought.

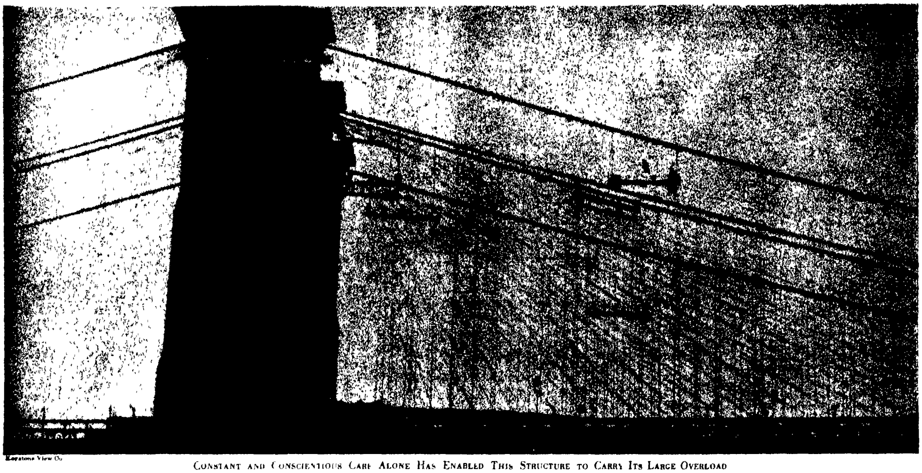
THE SOURCE OF THE WATER SUPPLY

Into the pool in the background ten mountain springs converge to be diverted to the ponds at the hatchery



TROUT PONDS ON THE HUNDRED ACRE HATCHERY

This view of the ponds was taken from the hatchery building. Each pond gets its own supply of fresh water



Keystone View Co

CONSTANT AND CONSCIENTIOUS CARE ALONE HAS ENABLED THIS STRUCTURE TO CARRY ITS LARGE OVERLOAD

$300,000,000 Annually Consumed by Rust!

Paint, While a Retardent, Is Not a Preventive. Only By Scientific Analysis of the Atom Structure Will Rust-proof Metals Be Developed

By D. H. Killeffer

Associate Editor, Industrial and Engineering Chemistry, Secretary, N. Y. Section, American Chemical Society

RUST prevention *looks* very simple. Perhaps that is the reason so many fantastic nostrums have been foisted upon an unsuspecting public to stop this universal waste. Perhaps, too, that is the reason scientists have disagreed so heartily and so long as to just the *method* by which it *might* be accomplished. Indeed, the inability of anyone to say exactly what corrosion is and how it acts has permitted our annual rust bill in the United States to mount to the astounding total of $300,000,000 annually! Structural steel, ships, railroads, water and steam pipes, the metal equipment of our industries, the multitudes of wires overhead and of cables below the ground and under the sea that make up the network of our communication systems, indeed every thing of metal that is necessary to our complex modern civilization is subject more or less to the ravages of corrosion and in the course of time adds its bit to the general waste.

Two Theories of Corrosion

The two theories of corrosion, which have formed the basis of much disagreement in the past on the subject, have each contributed methods of prevention which have succeeded to a certain extent and in that measure have been true. The difficulty has always come when the proponents of a partially true theory have tried to draw from their limited observations a version of that theory which would be universally applicable. Each investigator of the problem of corrosion has reached a theory based upon, and explaining, to his own satisfaction, the things he has seen himself, but lacking much of being able to explain all the observations of all investigators.

Early investigators supposed corrosion to be nothing more than simple oxidation of metal by the oxygen of the air. In fact, most statements of this theory compared corrosion definitely to ordinary combustion. Metal at ordinary temperatures was supposed to burn at a very slow rate, in much the same way that it can be made to burn like any other combustible material if heated sufficiently in the presence of air, or better, pure oxygen. The products of these two kinds of burning are quite similar except that that from low-temperature burning contains a certain amount of water in actual chemical combination which the other does not have, and that the one formed hot has been melted by the high temperature. Even these differences vanish if the low-temperature product is made hot enough to melt and drive off the water.

AN INSIDIOUS FORM OF RUST

As this form of rust is not open to inspection, even drilling tests may not develop the spot of maximum weakness

The New Theory Is Electrical

For the better part of a century, the simple theory, that a chemical action between the oxygen of the air and the metal itself was the sole thing involved in corrosion, served admirably to explain the problems which arose in regard to it. It was easy, for instance, to explain that corrosion was more rapid in damp atmospheres than in dry, for water has long been known to assist most chemical reactions.

On the basis of this oxidation theory and its many modifications, the method of preventing corrosion that offered most promise consisted in the simple expedient of putting a barrier between the metal and the air. Paint films of various kinds were quite effective in preventing rust so long as they themselves were perfect. Some paint films were better for this purpose than others. Sometimes rust continued to form even beneath a film of paint which seemed to be perfect. Other anomalies appeared as time went on and as the use of metals increased. The most serious of the difficulties encountered was that paint films had limited lives at best and had to be renewed at intervals if they were to continue

to protect the metal. This led to the development of metal coating methods which were based on the fact that some metals are less easily corroded than others.

Tin, nickel and zinc, and more recently lead, have been thus used in the form of thin films to protect iron from rusting. They have been successful in many cases, but, like paint, metal films have their faults. Perhaps the most grievous of these is that even a slight break in the coating will permit rusting to go on just as fast as before and sometimes faster than if the whole surface of the metal were exposed. It was not remarkable that the metal could be corroded through holes in the protective coating, but it was impossible to explain by the oxidation theory how corrosion could be so much more rapid at such points than it would be on a wide exposed surface.

This theory and the preventive measures based on it were quite satisfactory during the last century. It was about 25 years ago with the advent of skyscrapers that steel began to be considered a structural material and consideration of corrosion began only about that time. Hence it was not until 1903 that a theory of corrosion which would explain many of the anomalies of the older one was seriously advanced. It was not strange, in view of the advances which had been made at that time in the fields of both chemistry and electricity, that the new theory should bear a rather definite electrical stamp. When it came, it sought to explain rusting by the simple application of electrical theory, and the electrolytic theory of solutions.

Briefly stated, this electrolytic theory supposes that corrosion is the result of the formation in the exposed surface of metal of multitudes of tiny electric cells as soon as it is exposed to moisture or to an electrically conducting solution, and that the generation of current in these tiny cells results in dissolving metal at some points and depositing hydrogen at others. The differences in chemical composition, and hence in electrical potential, necessary to start such action were readily found in any ordinary metal by the use of the microscope.

GALVANIZING NOT ALWAYS A DETERRENT

As this illustration shows, this galvanized iron pipe is rust eaten from within and without

Many of the impurities in metals separate themselves from the main mass and are of sufficiently different properties to assure the passage of current when the surface is wet. The separation of carbon from gray cast iron and of various impurities from other metals readily lead to the formation of such areas of different potential. In addition to this type of separation, many alloys show themselves under the microscope to be made up of areas of quite different composition. Thus, it was easy to explain the corrosion of almost any kind of metal so long as there was some moisture available to form the liquid element of the cells, as a basis for reaction.

POWERFUL CORROSIVE ACTION OF RUST

This corroded iron plate, so rust eaten that it must be handled with the utmost care to prevent disintegration, was uncovered recently on the site of an extinct iron foundry

After the metal had been dissolved by this electrolytic action—local action, it is frequently called—the oxygen of the air readily converted it into the oxide or rust. It is possible, too, to explain by this theory why corrosion is more rapid through holes in a protective film, for certainly the difference in electrical potential between the film and the metal is greater than between different parts of the same metal. The result of this theory from a practical point of view was the development of very pure iron as a rust resistant, for if there were no impurities present the chances for local action were certainly minimized. Unfortunately, however, it is possible for this very pure iron to rust under certain circumstances.

High Hopes for Preventing Corrosion

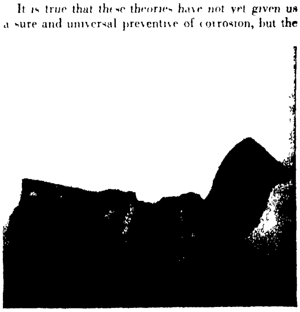
The "electrical potential" of a substance is really a very loose way of speaking of its "solution pressure." Solution pressure of a metal may be defined as its tendency to dissolve in a given solution, to throw off atoms as electrically charged ions. It is different for different metals in contact with the same solution and is also different for different solutions in contact with the same metal. The energy generated by an electrolytic cell is a measure of the differences in solution pressure at the two electrodes. In an ordinary dry cell, for instance, the energy generated, as measured by the voltage between the two poles, is proportional to the difference in the tendency of the zinc and carbon elements to dissolve in the sal ammoniac solution which fills the cell. Carbon has a very low solution pressure and zinc a comparatively high one. On this basis it is perfectly conceivable that certain metals and certain alloys of very low solution pressures may be found which would resist all ordinary efforts to corrode them, as gold does, for instance.

The solution pressure idea has led to another interesting advance in corrosion theory which seems to make the present theory broad enough to cover the entire field. This broadens the electrolytic theory, which had formerly considered only differences in the metal itself, to include differences in the solution in contact with the metal. Even slightest differences in solutions, such as are caused by the trifling amounts of oxygen that they will dissolve, are enough to make great differences in corrosion rates. For instance, if two identical pieces of iron be suspended in a weak salt solution and separated by a porous porcelain partition, a small but measurable current will flow through a wire connecting the two when air is bubbled up around one of them. This *combination is called a concentration* cell and operates by virtue of the differences in solution pressure of the same metal in contact with different solutions.

To show the relative amounts of corrosion which could be caused by concentration cell action and local action, recognized by the older theory, a concentration cell similar to that described was set up using ordinary iron and with a current measuring device in the line connecting the two electrodes. After this cell had operated for some time the loss in weight of the two electrodes was noted and the amount of loss which was caused by the cell action was calculated from the amount of current which had flowed. The current generated accounted for some 69 percent of the total corrosion loss and consequently only 31 percent was due to local action in the iron itself.

It is possible by this theory to account for the rusting of pipe lines buried in different kinds of earth along their length and for the rapid corrosion once a pit is formed in a metal surface. In the first case the difference in character of the water in soil of different kinds sets up concentration cells and in the latter case the easier access of air to the edge of a hole in the metal as compared with its bottom is sufficient to account for the formation of concentration cells which would cause a rapid corrosion of metal from the bottom of the pit. It is also possible in this way to account for the fact that a drop of water placed on a clean piece of metal will rust the center of the spot on which it rests leaving an unattacked ring around its edge where oxygen has free access.

It is true that these theories have not yet given us a sure and universal preventive of corrosion, but the agreement which has been reached among investigators concerning them now is sufficiently sure to permit the building of high hopes. A symposium on the subject held by the Corrosion Committee of the American Chemical Society last April was closed with the definite formation of plans for the building of an institution of research for the study in a thorough manner of corrosion problems. The institution which is to grow out of that meeting will be supported by users and makers of metals and is assured from its inception of the hearty support of the scientific world, a thing which would not have been possible ten years ago, so sharp were the disagreements on the subject.



A MENACE TO OUR HEALTH

Health depends in a large degree on our sewer and water pipes. Do we realize how rapidly rust deteriorates them?

General View of Furnace Creek Ranch, 170 Feet Below Sea Level

A "Garden of Allah" In Death Valley

How Irrigation Will Cause Date Palms to Flourish in Furnace Creek Ranch, One Hundred and Seventy Feet Below Sea Level

By John L. Von Blon

DEATH Valley will have a "Garden of Allah." Furnace Creek Ranch, the solitary oasis of that high walled, sun-blasted sinkhole, is being planted to dates. Despite its dread surroundings, possibly even because of them, it holds out bright promise as a future home of this sweet fruit of the Arab lands. Furnace Creek Ranch, one hundred and seventy feet below sea level, the lowest place where vegetation thrives and humans dwell, and the hottest spot on earth, thus becomes a place of special interest.

AN OASIS IN THE DESERT

In the heart of the world's hottest and most desolate waste. Note the Washingtonia filifera *and* Phoenix canariensis *palms reflected here*

This date undertaking, which is not a venture but an enterprise, is already well under way and will surprise the world. *It marks the extension of the* industry in an unexpected direction and apparently opens large possibilities. In addition to transforming the main area, experiments are to be conducted at various outside points with the object of making parts of the quarter-million square miles of California and Nevada desert bloom and yield to gratify man's wants and needs.

Water from Thermal Springs

Dr. Walter T. Swingle, noted explorer for the United States Department of Agriculture and principally responsible for the date industry in America, initiated the Death Valley plan after several years of close study. He is most enthusiastic over it, as, indeed, are other experts. Bruce Drummond, one of the foremost authorities and for seventeen years in active charge of the Government's successful date cultural work in the Coachella Valley, California, has been engaged permanently to direct operations at Furnace Creek, with headquarters at Death Valley Junction. He will reach far into the surrounding country in both an active and an advisory capacity; and he will give his attention also to other fruits.

Furnace Creek Ranch is in the flat part of Death Valley and only a hundred miles distant from Mt. Whitney, continental America's loftiest peak, which stands 14,501 feet high, and from the cliffs nearby, glistening palms and eternal snows are visible on any clear day. In that atmosphere a hundred miles is as nothing to the eye.

The soil on the ranch is a dark, heavy, fertile, sandy loam. The holding has been operated for many years as an alfalfa proposition, with forty to fifty acres under cultivation. Originally, it was the headquarters of the famous twenty-mule teams that made possible the past and present achievements of the borax industry. Hay was then grown for these *animals*.

About two hundred tons of alfalfa are now produced annually and fed to a herd of high-grade beef cattle, supplying meat for the tables at the

TO SERVE EXPERIMENTAL PURPOSES

Four acres of seedlings have already been planted and are making a splendid and healthy growth. These seedlings are three years old

A SOURCE OF FUTURE REVENUE

First Deglet Noor palm on the ranch. This palm is three years old and is exceedingly thrifty. Its eleven offshoots are worth $220

mines in the mountains, some miles above, at a camp called Ryan. The tillable ground can be increased to one hundred acres; and it is all to be devoted to dates.

Water—and there is an abundance of it in the midst of this, the most appalling desolation on the globe—comes from thermal springs on the slope of the Funeral Range, and is brought down by pipe line. These springs are really the source and entire supply of Furnace Creek. Incidentally the water is made to drive a little electric generating plant, an interesting sign of advancement in a primitive region that has seemed utterly unconquerable. The water is fine and clear, with a uniform temperature of seventy-four degrees, Fahrenheit, and the quantity is such that at present only the day flow is required for irrigation. The remainder runs off into the valley sump, two hundred and ninety-three feet below sea level, although evaporation and the sand claim most of it.

If, as the Arabs have it, "the date likes its head in the fire and its feet in the pool," the palms on Furnace Creek Ranch should be the happiest of their kind. The very air sizzles and seems almost ablaze, the dancing heat waves often resembling flocks of blackbirds not far away; and the mountain springs would fill many pools. Back of the old screen-porch ranch house a pool has been enclosed, a pool that is fascinating because of the general drab, and, ghastly outlook in all directions.

Reflected in this pool are the tall, columnar trunks of half a dozen specimens of the California native "wild date palm," *Washingtonia filifera*, and the glossy fronds of a surrounding group of wide-spreading *Phoenix canariensis*. The latter is a native of the Canary Islands and therefore accustomed to a moist sea climate, yet the growth, health and beauty manifested by this particular specie of palm in this exceedingly dry atmosphere so far inland, are quite remarkable and have attracted notice. There is substantial evidence that pal[illegible] rejoice here, for some of these trees are a quarter of a century old.

The primary idea at Furnace Creek Ranch is to turn out absolutely clean date nursery stock, without scale, insects or contamination of any kind, and thus help to supply the steadily increasing demand. It is believed that the major source of future revenue may lie in the sale of offshoots rather than in crop production, but the latter will not be curtailed further than is necessary to permit the strength of the palms to go to the trunks and foliage and provide nourishment so that both parents and offshoots will attain a size sufficient to withstand the severe shock of removal.

The whole industry's progress is dependent upon the number of such off-shoots that can be taken and saved during the period between the fifth and fifteenth years. The average palm is good for fifteen to thirty off-shoots, each of which is worth from fifteen dollars to twenty dollars. This estimate refers to standard imported stock.

Its Isolation an Advantage

Because of its isolated location on the bottom of a vast pit, hemmed in by many thousand square miles of forbidding desert, this unique ranch is the *one place peculiarly adapted to the growing of stock* which is perfectly free from pests of any sort whatever. Provided proper care is exercised it will be impossible for pests to get in, the prospective growers declare. Every precaution is taken to exclude them, even to the extent that plantings are accepted only under positive guaranty.

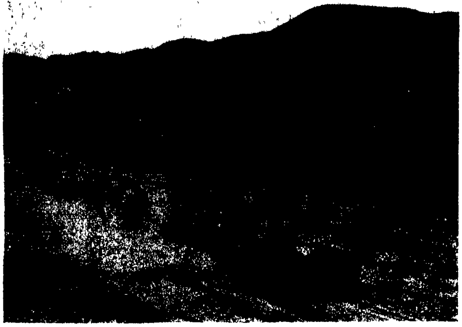
Four acres of seedlings, propagated three years ago, have been set out and are making an excellent showing, serving well the experimental purpose for which they were intended. Now the imported varieties are being placed. First of these is a Deglet Noor three years old, a handsome, luxuriant specimen with eleven off-shoots that bespeak its money bringing capability. It was selected by Dr Swingle and provided by the Government, which is greatly interested in this new garden, more than two hundred miles, as the crow flies, from those of the Coachella Valley, the date center of the United States.

BRUCE DRUMMOND AN AUTHORITY ON DATES

For seventeen years in charge of the Government's date cultural work in the Coachella Valley now has charge of Furnace Creek Ranch

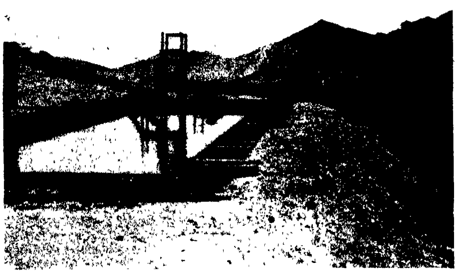
The Death Valley palms will be subjected to incredible heat, but they have already proved that heat agrees with them. The mercury climbs to 137 in the shade at Furnace Creek Ranch, and so much higher in the sun that no official record has been made. Few men have the hardihood to endure the hot season there, but always *one or two* may be found. The terrors of the region during those months cannot be exaggerated, but in winter and early spring it is a paradise abloom with wild flowers and aflutter with butterflies.

The new development is based on the belief that the date industry holds the greatest promise in the world in California. In that State and in Arizona, all the dates this country produces are grown. There are 1,200 acres set out and 700 acres in bearing. The output last year was 600,000 pounds.



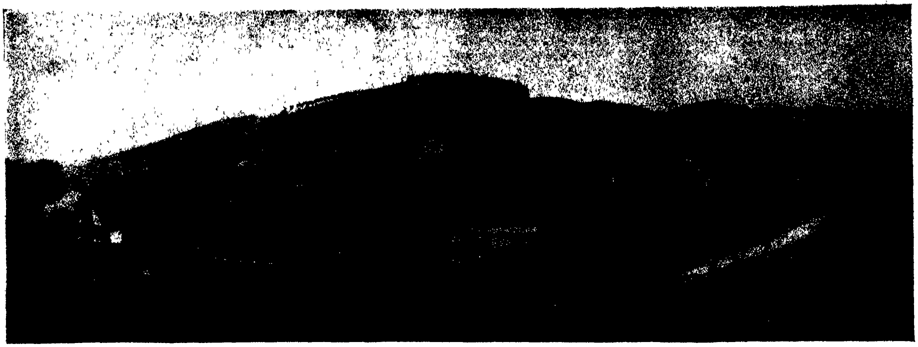
ONE OF THE FAMOUS TWENTY-MULE TEAMS

Hay was originally grown at Furnace Creek Ranch to feed the mule teams that made possible the borax industry



A WELCOME RETREAT FROM THE SOARING MERCURY

Where Death Valley picnics are held. The waters of Furnace Creek are piped into this pool just above the ranch



BUILDING THE CALIFORNIA MEMORIAL STADIUM

This huge structure, with a seating capacity of 78,000, is one of the largest in the country, and it is of particular interest because of the fact that its construction presented some unusual engineering problems. Hydraulic machinery was installed and jets of water under heavy pressure washed the earth from the sides to the floor of the canyon

New Arenas of Sport

Huge College Football Stadiums of Today Rival in Size and Seating Capacity the Ancient Coliseums of the Roman Empire

By Oscar Lewis

THE astonishing growth of popular interest in collegiate football during recent years has been one of the most remarkable developments in the history of American sport.

Fifteen or twenty years ago, 10,000 spectators was considered a remarkably large crowd to attend a football game. There were only a few athletic fields in the country capable of accommodating so many, and only a few contests, those between the chief colleges of the land, in which public interest was sufficient to fill even the comparatively small grandstands that then existed.

Again, contrast the relatively mild interest of that period with the state of affairs today. Crowds not of 10,000, but of 50,000, of 60,000, even of 75,000 and 80,000, gather for important games during the football season; and the fact that the number of spectators is not larger still is due to the impossibility of providing seats for all who desire to attend.

Amazing Popularity of American Football

It is easy to understand why American collegiate football has won this unprecedented popularity with the public. It is, with the possible exception of baseball, the most widely known and the most typical of our national games. Almost every schoolboy in the country has at some time or other played it, and is familiar with its fundamentals. It is a game in which keen thinking, quick judgment and agility count for more than mere physical strength, in which the co-operation of teamwork is vastly more important than individual "grandstand plays." Football, moreover, is one of the most thrilling of spectacles from the onlookers' point of view. There is a fascination about a well-played game between skilful, evenly matched teams that, in the opinion of many, cannot be duplicated elsewhere in the whole realm of sport.

The rapid growth of public enthusiasm for the game has brought about an interesting situation. Colleges all over the country presently found that their grandstands were totally inadequate to accommodate the crowds that wished to gain admission to every important game. Thousands of disappointed enthusiasts had to be turned away, and the committees governing the athletics of the colleges cast about for a solution to the difficulty. The one solution lay in the construction of larger playing fields. This task they presently undertook, and on a very large scale.

Football and the Classroom

The rise of inter-college football to its present importance has taken place within a single generation. The present nation-wide interest is due to the growth in size of our colleges, the better financial condition of the students, the introduction of inter-college competition, and the enthusiasm of a sport-loving public which pays liberally to witness these great contests of brain and brawn.

Are our colleges giving too much attention to sport? Do the exactions of the training table and the practice field demand more than their share of the students' time, thought and energy? Does play, carried to the high point of a match fought out before a cheering mass of 70,000 American citizens, unfit the students for work in the unemotional quiet of a college classroom? We think not. Rather, we believe (and the writer speaks as a former football captain) that the total effect is to promote that "sound mind in a sound body," which is the supreme goal of a college course.

EDITOR.

The college grandstand twenty to thirty years ago was a comparatively modest affair, both as to its size and its construction. Generally speaking, it extended down one or both sides of the football field, and rarely for its full length. The idea of extending the stands across the ends, thereby enclosing the whole area, as is done today, was not so much as thought of—this for the very good reason that, in those days, there was no demand for the large seating capacity that such an extension of the grandstand would have provided.

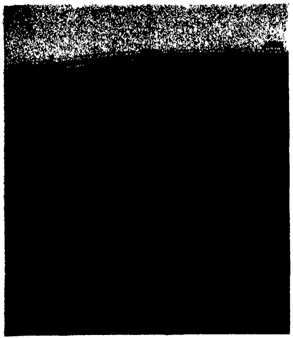
Some Stadiums Seat 80,000

The almost universal material of construction was wood, which was used for posts, sway-bracing, joists and the planking for risers and seats. The allotted space per spectator was by no means generous. The plank seats were narrow and so was the spacing. Hence it required some acrobatic ability to fit oneself into the conditions, and avoid overflowing one's neighbor or ramming one's knees into the back of the fellow in front!

But gradually we have changed all that. Wood has made way for steel and concrete; the individual spacing is more generous, so that one can sit in decent comfort; and the slope of the tiers of seats has been so carefully determined that one can be seated anywhere in a vast auditorium, containing nigh upon 100,000 souls, and be sure of a perfect view of the playing field.

The result of the growing interest in football has been the building of huge athletic stadiums, or "bowls," by dozens of colleges throughout the country. Having a size undreamed of a score of years ago, they are intended to be permanent settings for football games, and frequently for other athletic activities of the colleges. Their seating capacities range all the way from 40,000 to 80,000. Round or oval in shape, their huge tiers of seats are so arranged as to give every one of the vast number of spectators an unobstructed view.

The building of such a stadium is, naturally, a very large undertaking. A million dollars will



EXTERIOR VIEW OF STADIUM

The outside wall, pierced with arches, is reminiscent of the Roman Coliseum

hardly cover the cost of one of these modern football fields. A typical work of this kind, the California Memorial Stadium, recently completed on the campus of the University of California, will give an idea of the magnitude and great cost of such undertakings.

The structure has a seating capacity of 78,000, making it one of the largest in the country. The building of the immense oval occupied more than a year and involved an expenditure of $1,250,000. Its construction presented some unusual engineering problems, due to the fact that the only site available on the campus was in Strawberry Canyon, a comparatively narrow area, walled in on each side by steep hills.

Now the difficulties of building a great structure like that proposed on such a site might well have seemed to be insuperable. There was no precedent to go upon. Hitherto, the large stadiums of this character had generally been built up in steel and concrete upon fairly level ground. In the case of the famous "bowl" at Yale, the vast oval was formed by "cut and fill"—the material being dug out from the center and banked up upon the sides until, at the completion of the job, the lower half of the sides was below the original ground level and the upper half was above the original surface.

In the case of the stadium in California, the engineers decided to cut away the sides of the canyon and deposit the excavated material in the bed of the valley where the latter debouched on the open and generally level ground. By finishing off the excavated sides of the valley at the desired slope for the tiers of seats, approximately one-half of the great amphitheatre would be provided, for the concrete seats could be laid upon the firm, undisturbed material of the hill itself. This was the method used by the Greeks and later by the Romans, in the construction of their theaters. A natural, curving hollow in the hillside was selected, the ground graded to the required slope and the marble seats, which may still be seen, were erected.

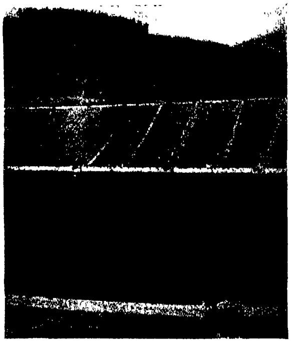
The Greek theater, however, was but a half-circle in plan, whereas this college stadium was to be a full oval. How was the other part of the structure to be formed?

Earth Removed by Hydraulic Streams

To accomplish this, the engineers adapted, with modern equipment, the methods used by the placer miners of early California days. A dam was thrown across Strawberry Creek, hydraulic machinery was installed, and jets of water under heavy pressure were trained on the hillside. With surprising rapidity the earth crumbled beneath the assault of the streams of water, was washed, dozens of cubic yards a minute, down toward the canyon's floor. This earth was, of course, not allowed to go to waste. The muddy streams were conveyed to the site of the stadium where they were allowed to flow into a temporary lake and deposit their soil and gravel Thus, as the hill melted away, the surface of the future football field gradually ascended and took shape above the floor of the canyon. Within a few weeks, 280,000 cubic yards of earth were transported by this means, the water draining away and leaving a firm foundation for the field

All this, however, was merely preliminary work. On this base of filled land the stadium itself was built. Its huge concrete walls were pierced by arches in a manner very similar to that of the Roman Coliseum, rising on the western or lower side to a height of 65 feet.

Inside, the completed structure with its acres of seats presents the appearance of a huge bowl, its sloping sides divided into forty-eight sections, each one of which contains seventy-two rows of seats. The great oval is carefully planned to insure rapid filling on the day of a game. Twenty-five subsurface entrances give access to the stadium, in addition to a like number opening from the runway on its eastern side, which is built against the base of the hill. With the help of the 300 student ushers required during important games, every one of the 78,000 reserved seats can be filled in less than an hour.

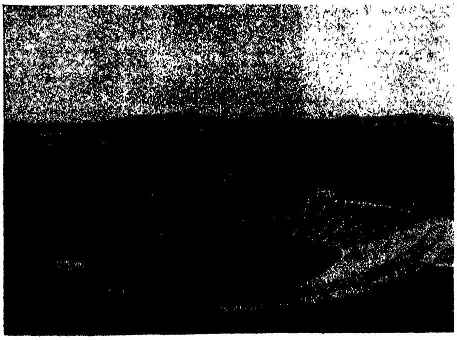


A SECTION OF THE STADIUM

Interior view showing the building of the concrete seats upon the embankment

In the building of modern stadiums the playing fields themselves receive, naturally, the utmost care. Drainage, turf, atmospheric conditions, the location of the sun's rays in relation to the goal-posts, each detail receives the most careful attention. For it is on the field that the game is played Upon this carefully prepared surface occur the thrilling contests, the matching of wit and skill and trained strategy, that has given football its hold on the American public, and that each season fills to their uttermost capacities the huge college stadiums of the country.

In conclusion, it is of interest to note that the famous Coliseum, whose majestic ruins are, perhaps, the most impressive sight in Rome, is credited by some authorities with the same seating capacity of 78,000 to 80,000 as the modern stadium of the University of California



LOOKING DOWN UPON THE STADIUM

This great structure, built at the mouth of a valley, has a seating capacity of 78,000 Structure in foreground rests on excavated hillside, further portion carried upon concrete substructure

WASHING DOWN THE HILLSIDE

Hydraulic sluicing was employed to break up the rock and earth and fill in the canyon, thus forming the center playing field, which was then leveled and sodded

IN THE MAIN TUNNEL

The electrically operated work train on its light track

THE DRILL CARRIAGE USED

The pneumatic drill in its eight foot by eight-foot heading

The Six-Mile Moffat Tunnel

By Means of Special Equipment the Main and Auxiliary Tunnels Are Being Driven Side by Side Through the Rockies

By George F. Paul

MODERN machinery is doing its full share in speeding up the work on the Moffat Tunnel which, six miles in length, is to pierce the Rocky Mountains to the west of Denver Immense quantities of rock are to be moved in driving this tunnel In reality there are two tunnels running parallel to one another The smaller tunnel, eight feet square, is later to be used to convey water from the west side of the Rockies to the east side This pioneer bore is connected with the railroad tunnel by means of cross-cuts at intervals of 1,500 feet

THE AUXILIARY TUNNEL

To facilitate excavation this eight foot-square tunnel is being driven parallel to the sixteen foot by twenty four foot tunnel

A special air-hoist has been devised for switching the muck cars. By means of the hoist, muck cars are picked up and switched laterally This operation gets rid of all the delays and derailments that might otherwise be encountered The operating cylinder is suspended from a little trolley that runs on a steel bar.

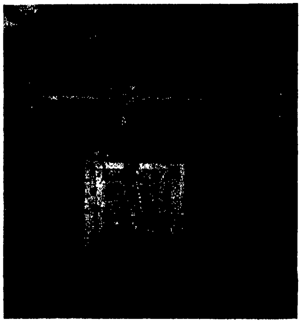
In order to save time in moving the drills at the headings, special carriages have been devised A channel bar frame supported on a track has a trolley with steel columns on each side, and these are held rigidly together by means of horizontal cross bars Screw jacks hold the bars against the side walls when drilling is being done. Within less than fifteen minutes after the time of arrival, breast drilling can be started When the drill crew are working in one tunnel, the muckers can be at work in the other. Then they can shift places.

An apron, scoop and endless belt convevor are features of the mucking machine Four men are required to operate one of these machines. With this equipment they can load a car of fifty cubic feet capacity in about two minutes. This means that something like fifty tons of material can be handled in two hours The apron and scoop swivel from side to side. A 50-horsepower motor drives the scoop deep into the muck pile.

Total Excavation 522,500 Cubic Yards

Faster progress has been made from the east portal than from the west. This difference is due to the fact that the crews working on the west section encountered much more difficult working conditions. Before the work started, geologists predicted that solid rock would be encountered at a penetration of about 1,500 feet. However, their predictions have not come true. The soft rock continues even at a depth of 6,000 feet. It has slowed up the work and has added greatly to the engineering problems.

The vastness of the project can be comprehended when it is considered that the estimates place the total rock excavation at 522,500 cubic yards. To handle this great volume of material, men working in eight-hour shifts are on the job day and night. Electricity for lighting and other purposes is generated at a station on South Boulder Creek. Direct current of 250 volts is supplied for driving the mucking machines, electric locomotives, blowers, et cetera The air for the compressors is delivered to the headings by means of an eight-inch line that is carried through the water tunnel Then smaller piping conveys the compressed air through the cross-cuts to the points where it is required. Fresh air is a prime essential for the men working at this altitude. A ventilating plant has been set up at each portal capable of delivering close to 25,000 feet of free air per minute to the various headings.



SWITCHING THE MUCK CARS

This air hoist switch avoids delays The muck cars are hoisted from the tracks and moved across on the transverse bar

Good working conditions for the men have done much to keep up their morale; good meals and good wages have done their share too. Having satisfied workers means much in a big project of this nature, where the work extends over a long period and where the ultimate success of the undertaking depends to a great degree on the loyalty of the men.

The Persian Lamb and Our Fur Industry

How the Crossing of Pure Imported Karakul Sheep with American Breeds of Sheep Will Make Possible the Production of Valuable Furs in the United States

By Guy E. Mitchell

FOR the furs of wild animals, used in producing my lady's coat at reasonable cost, the end is in plain sight; in fact it is already here. It is fortunate that furs are no longer a real necessity, for they are one of our most rapidly vanishing resources Since the war the demand for furs has brought a good many people easy money and has somewhat changed our standards. This has resulted in the practical extinction of fur-bearing animals throughout large regions where they were formerly comparatively plentiful and where they were not hunted and trapped so persistently as to prevent reproduction. With this decrease in local production, the corners of the world are being searched for furs.

VERY YOUNG KARAKUL LAMB

The wool of the young lamb is soft and lustrous, and the curl is tight, uniform, and evenly distributed

What is the answer, then, with respect to furs? Just this, that sooner or later we will have to raise most of our fine furs just as we now raise beef where once people lived on deer or buffalo meat

The recognition of this fact has stimulated a few of the far-sighted ones to breed an American flock of Karakul sheep from the lambs of which the famous Astrachan or Persian lamb fur is produced This fur is now a great favorite, and garments made of it are successful competitors with the finest of fur coats made from the skins of wild animals. In fact these skins are classed by the trade and by the wearers as "real fur."

The production of this fur in the United States seems to be entirely feasible and should certainly prove commercially attractive. It is now imported mostly from Bokhara, in Central Asia, where there are reported to be some 3,000,000 or more Karakul sheep, from the three-day old lambs of which the fur is obtained Curly, with a beautiful gloss, it is in strong demand for women's fur garments. Its increasing popularity has caused a steady advance in the price of these skins. Those of highest quality sell in New York for from eight dollars to twelve and a half dollars each; and even inferior skins bring three dollars apiece. This is no small price, especially when it is realized that the average is fifty or more skins to make an ordinary sized coat.

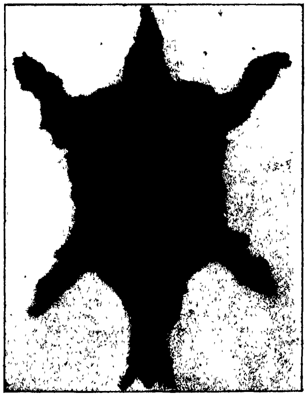
Karakul sheep thrive in the United States. This has been well demonstrated. The greatest difficulty in quickly establishing an American industry has been in securing importations of a sufficient number of pure-bred animals There are now about 500 pedigreed sheep listed in the American Fur Sheep Registry. It is from these that an American Astrachan and Persian lamb fur industry must be built up.

This process would be exceedingly difficult and slow if it were not for the promise of cross-breeding In this possibility—the crossing of pure Karakuls on American breeds of sheep—lies the future of the industry. It is to such experiments that the animal specialists of the Department of Agriculture and several private breeders are giving their attention. The results of some of these crosses are more than promising, it is stated by Government specialists, they are successes. Additional importations would be desirable, but they are practically prohibited by the strict quarantine of sheep on account of the dreaded foot-and-mouth disease to which sheep are subject We must depend, therefore, on what we already have.

Keynote Must Be Breeding

Mr Henry Hoffman, the registrar of the American Fur Sheep Registry, who has recently made a trip throughout the west and the northwest investigating the Karakul situation, says:

"There is a real future for Karakuls in America, but there is a lot of 'rubbish' being sold as Karakuls which do not produce fur, and this practise tends to injure the industry Owners of questionable sheep are clamoring to be admitted to registry, but they have got to produce the goods The American Fur Sheep Registry stands ready to register only sheep that can show a pedigree back to imported animals on all sides which have produced lambs with pelts of greater value as fur at the time of birth than the lamb at five months would be worth for meat"



CLASSED AS PERSIAN LAMB

The tight, even curl and fine luster are main factors in determining its value

While these pedigreed Karakuls are, of course, of the utmost importance as a foundation, for an Astrachan Persian lamb fur industry, the great promise, as stated, lies in the assurance that American animal breeders will be able to cross these sheep with some of our well established American breeds, and that we may confidently look ahead a few years to seeing an American strain of Karakul that will produce lambs furnishing uniform furs of highest quality, possibly a much better product than the average of the furs now imported

Immediate production, however, must not be expected--not until we have developed large flocks of Karakul sheep The reason that greater progress has not been made during the last few years is that at least some American breeders have apparently been working with either too little capital or have not appreciated the possibilities of the industry They have been trying to market skins instead of devoting themselves exclusively to increasing their flocks. The keynote must be breeding rather than killing for immediate profit the new born lambs

IMPORTED KARAKUL RAM

Note that the wool of the mature sheep is straight, wiry and almost white It is of very little value

The furs known as "Persian lambskin," "Astrachan," "Moiree," and "Krimmer" are taken from the young Karakul lambs These lambs are killed when from two to five days old, because the curl and gloss rapidly deteriorates with greater age The skins of prematurely born lambs also have a value for fur, but the somewhat current idea that Persian lamb fur is derived from lambs removed from the ewes before the time of natural birth is erroneous.

Valuable as is the fur of the young lamb, soft, fine haired and glossy black, it appears curious that the wool of the mature sheep should be long, straight, wiry, and almost white, it is of the least value of that of almost any breed of sheep The young lambs must be watched closely, however, like a quick-ripening fruit for they must be killed at just the right day almost hour A delay of a day may loosen the curl of the fur or add to the thickness of the skin and thus halve the price of the pelt

The Karakul is a heavy type of sheep, succeeding at a fairly high altitude and in a dry climate Many of our western sheep ranges would, it is stated, furnish the exact requirements

Dr Turrentine in his Washington, D C., Laboratory

Goiter—A Dietary Problem

By J. W. Turrentine, Ph.D.

When one makes the statement that the American Nation is goitrous, surprise and incredulity result, especially when the assertion is made to an American. Such a statement, however, not only is warranted by the facts but is particularly justified by the consideration that it may serve to arouse the American people to a realization of the true state of affairs pertaining to an important phase of public health. Certainly America is goitrous, to the extent at least that the majority of Americans are confronted by a distinct goiter menace.

Already a keen realization of this danger is being experienced by certain communities, as witness the State of Michigan inaugurating its newly enacted law requiring the addition of iodine to all salt sold for dietary use, and the City of Rochester, New York, dissolving iodine in the city reservoir, to enable—*to force* the people to acquire a more nearly adequate quantity of an essential element normally deficient in the diet.

Goiter Threatens the Mind

The aroused state of the public mind on this branch of public welfare has resulted from numerous medical surveys by federal, state and municipal health agencies to determine the incidence of goiter among the members of the communities chosen

These surveys, for the most part, have concerned school children, possibly for reasons of convenience, and also because preventive measures are here more effective.

In most instances these surveys reveal an appalling state of affairs, showing as they do a large percentage of the school children already victims of incipient goiter and threatened with the dire sequence of mental and physical sub-normalities toward which that condition heads.

If the entire race had perpetual hay-fever, the symptoms would escape notice, being accepted as the natural order of things. In some communities the prevalence of goiter has reached this stage, particularly is this true in certain European localities.

Similarly, the concomitant mental deficiencies become merged in the general average, for the stupid child gets its share of parental affection and family care; and, after all, the chances are that its mental shortcomings are appraised by those suffering from the same lack of cerebral stimulation resulting from the same cause.

Goiter surveys now taken in many states from the Appalachians to the Pacific Ocean show incidences of as high as 75 percent in groups of schoolgirls of about 18 years of age and as high as 50 percent of entire school populations. Incidence being greater among girls than among boys, and particularly high among girls of adolescent age, the results vary with the bases on which surveys are made. It may be accepted, however, as a conservative estimate that 50 percent of the adolescent girls of the northern half of the United States, have incipient goiter.

HARVESTING KELP FROM THE SEA
Kelp is astonishingly rich in the kind of iodine which the body can assimilate as a goiter preventive

The cause of goiter is iodine deficiency. This fact is now established beyond a peradventure. Its cause is the absence and its prevention the presence of assimilable iodine in the diet. Goiter is generally taken to mean specifically an enlargement of the neck caused by the swelling of the thyroid glands there situated. It is, in fact, far more than that. It is a condition brought on by abnormally functioning thyroid glands, and manifests itself in a great many ways.

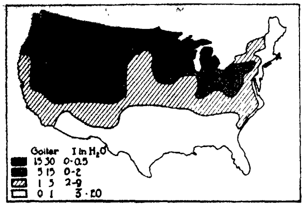
What These Glands Do

The substances secreted by the thyroid gland govern the growth of all cells. They promote metabolism and tend to prevent obesity. They act as a profound katabolic stimulant, facilitating the breaking down of exhausted cells and governing the elimination of the waste products of their disintegration. They exercise a protective antitoxic and immunizing action, defending the body not only against the toxic products of its own metabolism, but against invasion by disease-producing micro-organisms and injury by their products. They are a potent aid in the recovery from disease. They are specifically associated in the exercise of their functions with the generative organs.

Is anything more needed to show the fundamental importance of maintaining the thyroid gland in a condition in which it can supply the body's full requirement of normal secretions?

Important among the substances present in these secretions is thyroxin, a complex organic compound containing iodine, for the manufacture of which the thyroid gland utilizes the iodine taken into the body as a natural constituent of food materials.

When the supplies of iodine are inadequate, the secretions are inadequate and the demands of the



WHEREVER IODINE IS DEFICIENT THERE IS GOITER

In one of these three goitrous areas—Michigan—the law requires that iodine be added to table salt

various body functions go unanswered. As if in realization of its shortcomings, the gland undergoes compensatory hyperplasia, that is, it seems to feel that if it were larger it would be more efficient. It therefore grows in size and the swollen neck thus becomes the outward manifestation. When iodine is supplied, however, in a form assimilable by the gland, the situation is relieved, the secretions again become satisfactory, the demands become less insistent and the gland returns to its normal size.

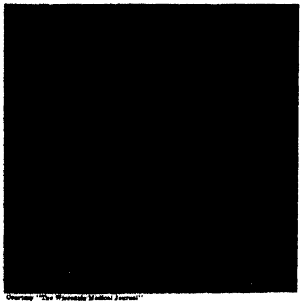
But when this period of deficiency is prolonged, especially during the time when these secretions are needed for structural, sexual and mental development, as in youth and especially in adolescence, the results are irreparable, for without them the child is unable to metamorphose into the perfect adult.

Many Localities Lack Iodine

The sea is the world's great iodine reservoir. Iodine compounds for the most part being readily soluble, they have been leached from the rocks and soils of the earth's surface and carried into the sea. The rocks formed on the ocean's bottom and lifted up to become dry land carried small quantities of iodine dissolved in the sea brine with which they were originally saturated, but the rains of the succeeding ages have leached them out and deposited them again in the sea. The process, fortunately, is still going on, for in rivers and subterranean waters iodine is still to be found, but in quantities that are little more than traces. What has been leached from the soils of regions lying at higher altitudes, has been carried down, over and through the soils lying at the lower levels, leaving the soils at higher levels, more thoroughly leached than the lower.

Analyses of the potable waters of the country show less and less iodine as the tops of drainage areas are approached, and, conversely, more and more as, following the direction of drainage, the sea is approached. Precisely the same is found to be the case with respect to goiter incidence, but in the reverse ratio. Goiter incidence increases as the tops of drainage areas are approached and as the iodine content of the drinking water decreases. But the iodine content of all soil water is so low that, it is obvious that the individual must obtain his iodine from food materials or artificial products and not from drinking water.

Soil water enters plants through their roots and evaporates from their leaves, leaving behind in the tissues of the plant any iodine which it carried. Thus, plants are found to contain small amounts of iodine, the amount being determined by the iodine in the waters of the soil in which they grow. Food products grown in inland regions of iodine scarcity are much lower in iodine content than those grown on the coastal plains. There is, accordingly, a correlation between the iodine content of the foods grown in a given region and goiter incidence. To illustrate: in the wheat from inland regions there is to be found one milligram of iodine per ton, in dried apples, two milligrams; in oats (including the husks), 10 milligrams, and in spinach and stringbeans, both dehydrated, 18 and 29 milligrams, respectively. The growing child, it is authoritatively estimated, should have a daily supply of 0.1 milligram of iodine. To acquire its rightful share of iodine from such a diet, the child would have to eat daily, 200 pounds of wheat, or 100 pounds of dried apples, or 20 pounds of oats or 11 pounds of dry spinach, or seven pounds of dry string beans.



Courtesy "The Wisconsin Medical Journal"

CALLOID GOITER WITH MULTIPLE ADENOMAS

Age seventeen. The asymetric appearance of the enlargement demonstrates the presence of three groups of adenomas

Animal products, with the exception of rich milk and butter, are no better, for the animal must rely for its iodine on the same inadequate sources as the human being; the same holds true for fresh-water fish.

Three Million Times as Rich as Wheat

Sea foods, on the other hand, are the only materials in general dietary use that contain anywhere near adequate quantities of this essential element, but, unfortunately, because of the high costs of preservation and transportation, they are unavailable for the vast majority of the population Sea fish, such as blue-fish, contain 260 milligrams of iodine per ton, as contrasted with wheat containing one milligram, while oysters contain 1,160 milligrams per ton The child fortunate enough to have provided for it a diet containing these delicacies would be able to acquire its essential tenth of a milligram if it ate one pound of blue-fish per day or one-fifth of a pound of oysters.

In the category of food materials, embracing land vegetables and meat products from both land and sea, no mention is made of sea vegetables, and here it happens is to be found iodine in truly phenomenal concentrations. Sea vegetables, by which we mean the marine algae, among Americans are practically unknown as articles of diet, although among the Japanese they are quite generally eaten.

The iodine content of marine algae, as compared with land plants, is astonishing. To illustrate: As compared with one milligram per ton in wheat, 10 milligrams in oats (including the husks), 18 milligrams in dehydrated spinach, 260 in blue-fish and 1,160 in oysters, one well-known species of marine alga contains 3,000,000 milligrams per ton! Thus the smallest "pinch"—to use a culinary term—of pulverized sea alga of the right sort contains more iodine than all the rest of the dinner and pantry supplies combined, and, being natural vegetable iodine, its use represents the immediate and complete solution of the iodine deficiency problem

Sea vegetables, as they are harvested from the marine farm, have an odor and taste which are not stimulating to the appetite. They readily ferment and turn sour. When dried they are salty to the taste.

To render them available for general dietary use, sea algae, by methods now completely developed, may be processed to yield a flour, in appearance resembling graham flour, which can be added to the ordinary articles of diet in any way that is convenient Since such small quantities are sufficient, its presence need not be detected It may appear on the table as an invisible part of the dishes prepared in the kitchen, or it may come from the grocers as an ingredient of cereals or bakers' products, as bread for the family or as cakes for the child's lunch box. By its use the inadequate and debilitating wheat of the plateau regions may be given the vitalizing properties of the products of the sea.

The iodine-rich extract of these algae, prepared in tablet form, is now successfully employed by physicians and hospitals as a therapeutic agent for the treatment of goiter. Its great efficacy as a curative agent, even in advanced stages of that disease, is remarkable.

Thyroxin Potent in Life Processes

There is abundant evidence that the iodine of sea plants is comparable in nature to that of land plants. This conclusion, however, does not go far enough, for there is reason to believe that this iodine may be potent in its influence on the thyroid by virtue of the fact that it is a constituent of a definite chemical compound of peculiarly thyreotropic properties In the complex compound, thyroxin, extracted from the substance of the thyroid gland, we have an example of an iodine-containing molecule that is very profound in its control of many life processes.

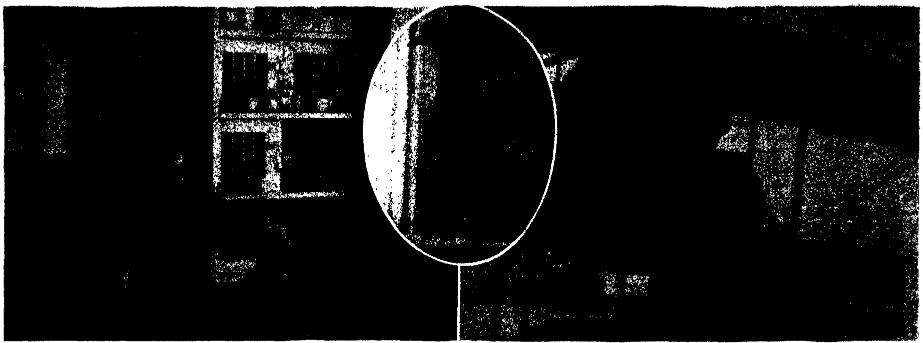
If there be present in these algae an iodine compound comparable to thyroxin in any important characteristic, it should be isolated in the pure state, its structure and properties determined and its synthesis attempted.

Marine algae are abundant and, being self-perpetuating, are inexhaustible. They may be harvested by sea-going reapers by the thousands of tons Properly preserved and distributed they are capable of proving a boon to humanity. Their importance as an industrial raw material source for chemical iodine, potash, table salt, decolorizing carbons, plastics, sizing, stiffening and water proofing materials, acetone, oils and organic solvents, has been disclosed in recent researches There is no use to which they can be applied, however, that compares in importance with their use as a source of vegetable iodine for human consumption By their judicious use goiter among civilized races may be eradicated.

Courtesy The Wisconsin Medical Journal

THE SAME CONDITION IN A GIRL OF EIGHT

While iodine is not harmful, it is ineffective once such adenomas (gland tumors) as these have developed



HOW THE NAVY CARES FOR AND USES ITS PIGEONS

Left: *Pigeons require expert medical attention to keep them in the best physical condition. If a pigeon contracts a disease, it is isolated in this hospital or "sick bay" until pronounced cured.* **Right:** *Homing pigeons are carried in a four-bird box divided into compartments. If a plane is disabled or forced down away from its base a pigeon is dispatched to report the trouble.* **Insert:** *This typical Navy Homing Pigeon, besides winning races has demonstrated its utility for carrying messages*

Interest Revived in Racing Pigeons

THE sport of pigeon racing is fast spreading over the country under the fostering guidance of journals specializing in pigeon breeding. Associations are holding state and sectional meets at which attractive purses are offered to those who bring out the fastest birds. In this way we are discovering the strains which are best for breeding purposes. Pigeon racing is also very popular in Belgium, France and England. In olden times the pigeon was considered sacred in many oriental countries, and is yet so considered in a few localities. The Greeks used them to carry war messages, as did Brutus, the Roman officer.

The earliest record of their use in war dates back to 1574, when the Spanish were besieging Leyden. The Dutch were about to surrender when a pigeon arrived with a message stating that help was coming! The besieged thereupon made a desperate effort and were able to hold out until reinforcements arrived. The French used them during the siege of Paris in 1870. During the early Indian Wars of America pigeons carrying messages were sent through lines held by the Red Men.

The racing and homing pigeons are quite different from the carrier pigeon. The first is beautifully formed, slender, graceful and bred to fly as swiftly as a locomotive, one having made a record flight of a mile and eighty-seven feet in one minute. These are not loft-free birds—that is, they cannot leave and return to the loft at will. The "homer" is quite another pigeon, beefy and large, bred for the table, while the carrier is an awkward, large bird with a peculiar wart-like growth on the nose and around the eyes. The last-named is bred for exhibition purposes, although it too has home-loving instincts and will fly long distances. The racer, as well as all of the fancy pigeons, is descended from the Wild Rock pigeon of Europe, of which the Antwerp and Liege types were the pioneers.

Some of the fastest racing homers are in the naval loft at Anacostia, D. C. In addition to carrying messages, the racers are used in the Air Service because they will fly higher than other types of birds.

Several methods are employed in sending messages. One is to attach a letter to the tail feathers of the bird. Another and much better way is to set the message up in large type, photograph it down and place the message in a tiny capsule which is attached to the body of the pigeon. When the bird reaches its destination, the capsule is opened and the message is magnified by photography.

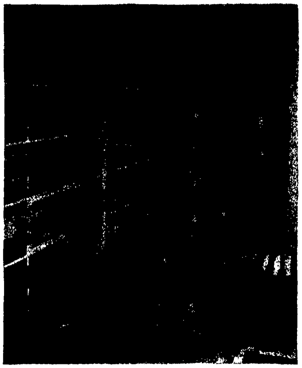
The racing pigeon is also used for the purpose of taking photographs. Neubronner, of Germany, invented a tiny camera which is used for this purpose. It takes about two dozen views and is less than two inches square, being made partly of aluminum with a weight of two and a half ounces. It has two lenses, working in two tiny cameras, one turned forward and the other backward. It works from every direction and is attached to the pigeon by bands and straps. A tiny rubber ball operates a small lever which is attached to the shutter. Air passing through the ball causes the lever to relax its hold on the shutter, and in this way the photograph is taken. With this camera attached to its body, the pigeon, circling over the surrounding country, takes numerous pictures.

Thus, pigeon breeding and racing combine both sport and service and are therefore sure to become well patronized throughout the country.

Courtesy of V. J. Lonnefeather

CLASSED AS A GRIZZLE

"Ziggie," above, is the Wisconsin champion. His progeny is now in California, Japan, Canada and many other places



INTERIOR OF PIGEON LOFT

Like well trained sailors these birds of the Anacostia loft stand as placed. A bathing fountain is part of the equipment

Courtesy of J. E. Reynolds

A SPECIE NOW EXTINCT

This passenger pigeon once was seen by the million in this country. Next to the frigate bird it was the fastest flyer

THIS MAGNIFICENT TREE IS NOT A MYTH
It is a saman tree, growing on the island of Trinidad, British West Indies It is credited with water-transpiring powers, and goes popularly under the name of Peruvian Rain-Tree

THE MARVELOUS RAIN TREE OF THE ISLAND OF FERRO
This old print, which appeared in E T Charton's "Voyageurs Anciens et Moderns," shows the tree in the full vigor of its activities Note the natives collecting the water in jars

The Mythological Rain-Tree

Fifteenth-Century Travelers Told Tales of a Marvelous Rain-producing Tree

By Dr. Leon Augustus Hausman

Professor of Zoology, Rutgers University

THE rain-tree story, like the story of the sea-serpent, is ever with us. It will not down. According to the accounts, the rain-tree is a marvelous tree found in certain islands of the North Atlantic, in Peru, and in other parts of tropical South America, which sheds water copiously from its leaves—so copiously, in fact, that the ground beneath the tree is converted into a veritable bog from which brooklets run in every direction to water the thirsty neighboring territory! And not only can the tree produce its own rainstorm beneath its branches but, singularly enough, it can do so with much greater vigor and benefit in dry weather, when brooks are at their lowest and water scarcest! Serious reports have again and again advocated the culture of such trees in arid regions. Single trees have been estimated to produce as much as nine gallons of water per day.

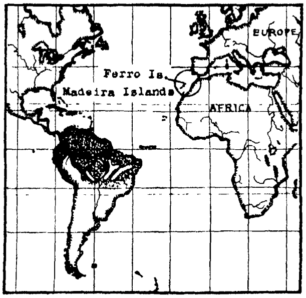
How the Story Started

How such a realistically detailed conception could have arisen is difficult to say. For, of course, the whole thing is a myth. There is no such tree as the rain-tree. And yet there are indications in the stories of early travelers and in the studies of modern naturalists which suggest the origin of the rain-tree legend.

Not until about the middle of the Fifteenth Century do we find the rain-tree definitely located. Accounts of voyagers at about that period locate it on the island of Ferro, near Madeira. This island is a high, rocky mass which rises from the water's edge, in some places as high as 5,000 feet. The whole island, says one account, depended for its moisture upon the rain shed from the branches of a single tree! No springs could be found upon the island, and no rain from the clouds was ever known to fall there. In 1863, the story was still in full enjoyment of general credence, and was incorporated in E. T. Charton's fascinating *Voyageurs Anciens et Moderns*, published in Paris in that year.

Next, the story was attached to a certain tree in tropical South America, the well-known saman tree. The saman tree is not a myth. It is a huge and beautiful tree, rooting deeply, and sending up a stout trunk bearing a crown of leaves that is truly a marvel. In some saman trees this crown stretches out so as to cover more than half an acre of ground. But, as if this were not enough to distinguish and ennoble the tree, legend must accredit it with the miraculous power of rain-producing.

Because it was found abundantly in Peru, the saman tree goes under the name of the Peruvian Rain-Tree. It is also called the giant Thibet tree, South American acacia, zamang, and genisaro. Botanists know it under the name of *Pithecolobium saman*, the generic name meaning monkey ear, and referring to the shape of the large curved pods. We know much concerning the saman tree, for here we are dealing with a real tree, and not—as was the case with the Ferro rain-tree—with a mythical vegetable. Yet we know nothing (except by hearsay) of its wonderful water-transpiring powers. And these powers would be quite the reverse of what we should expect a normal vegetable to exhibit. It is true, of course, that leaves of trees and plants in general do transpire some moisture, frequently—in some forms—enough so that globules of water roll down from the leaves. But this never happens in dry weather or in a dry territory, and never enough to produce anything like a shower



WHERE THE "RAIN TREES" GROW
The Peruvian Rain-Tree, or saman, is found all over tropical America, and on the nearby islands

With regard to the story of the Ferro rain-tree it seems reasonable to suppose that sailors had noticed that there were no springs on the island, and further more that the trees on the uplands were dripping with moisture. This latter phenomenon can be seen by anyone today The explanation is that while no rain falls on the island, yet the uplands are frequently buried in dense fogs, which condense their moisture on all they bathe, particularly on the leaves of the trees. Thus, and not otherwise, is the island supplied with water. This seems but an unsubstantial basis for such a tale as that of the rain-tree, but it seems the only one we can find

A Celebrated Botanist Explains

Now, with regard to the rain-giving qualities of the saman tree First, let us note that no one has seen a shower of rain going on under the branches of this tree—at least no one who reported it afterwards. And now, for a record of an observer about whose powers of observation and recording there can be little question, the celebrated English botanist and traveler, Dr Spruce He says, writing of his experience in September, 1855, in Moyabamba, Northern Peru·

"I had gone out one morning at daybreak with two assistants into the adjacent wooded hills, to botanize. A little after seven o'clock we came under a lowish spreading tree (the saman tree) from which, with a perfectly clear sky, a smart rain was falling A glance upward showed me a multitude of cicadas (we term them popularly, locusts) sucking the juices of the tender young branches and leaves, and squirting forth slender streams of limpid fluid.

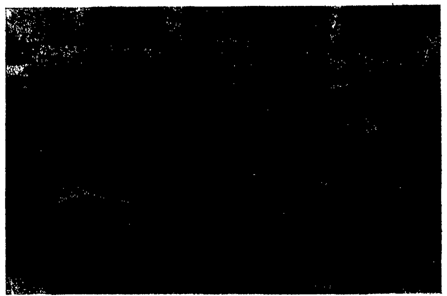
"Those who have noted the copious discharges of fluid from the aphids which sometimes infest our city shade trees will have no difficulty in conceiving of this phenomenon It seems very probable that this phenomenon, seen by those who allowed it to lose nothing in the recounting of it, accounts for the stories of the rain storms which descend from the leaves of the saman tree"

From the Scrap-book of Science—C mera Shots of Scientific Happenings

Keystone View Co

A NEW MASK FOR PACE MAKERS

Leon Lauthier, motor cycle pace maker, while setting the pace to Brunier in his new bicycle speed record, wore this mask. A tube, opening behind, enabled the pace maker to coach the cyclist


Wide World

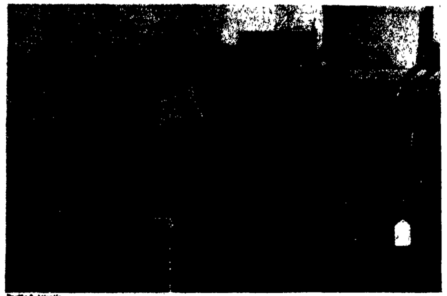
TESTING A GIRDER OF THE *SHENANDOAH*

A scientist at the U S Bureau of Standards subjecting the girder to a slowly increasing compressive stress The deformations of its various members are read on five dials. This testing machine can exert a force of hundreds of tons—or crack an egg!

Pacific & Atlantic

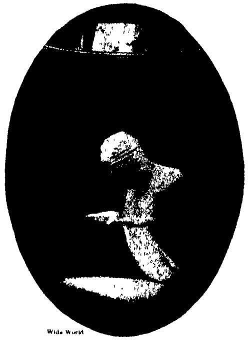
HOW X RAYS ARE HT TO THE HOME

Patients who cannot be removed to a ho e X-rayed at home. Power generated in the car reaches the tube via flexible wir e wire is for a telephone to the bedside. The car contains a dark room veloping the film immediately


Pacific & Atlantic

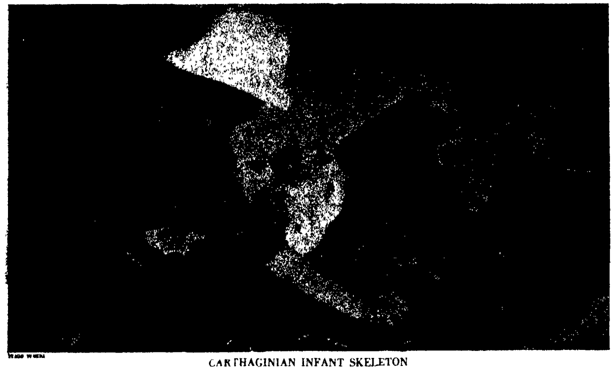
CAN YOU "BEND" A BRICK WALL?

An instrument, by means of which the minute deflexion of a 40-inch brick wall may be measured when you press it with your hand, has been perfected by the U S Bureau of Standards. The scientist is observing the tiny movements through an eyepiece


Wide World

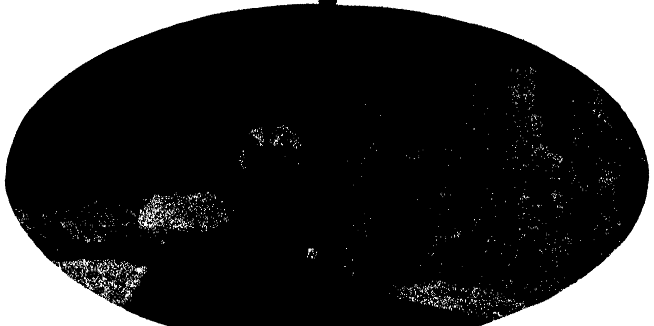
LIGHT WITHOUT SHADOWS

Surgical and other work is hampered by shadows. A lamp with a cylindrical prism sends its rays to the silvered reflectors They focus on the work from many angles Hence no shadows


Wide World

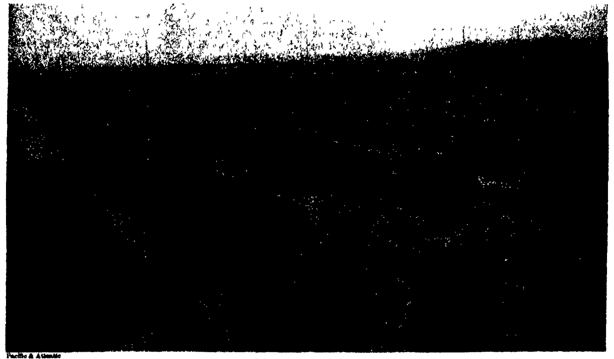
CARTHAGINIAN INFANT SKELETON

On the Algerian site of ancient Carthage, destroyed by Rome, Count de Prorok's expedition has been finding many evidences of a vanished civilization Here is a baby's skeleton found in an urn dug up at the Temple of Tanic, a Punic goddess


Pacific & Atlantic

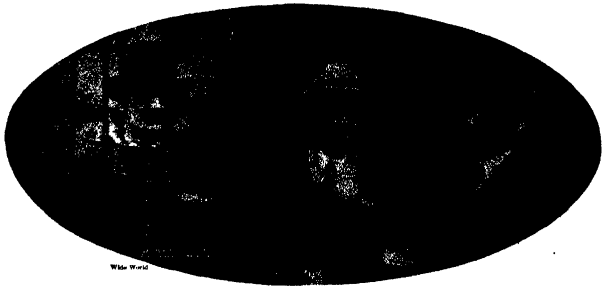
FINDING "TH T WORLD"

Scientists of the Smithsonian Institution, at Washington, D. C., a ually reconstructing the fossil skeleton of an eighty-foot dinosaur, an extinct reptile found by Prof Charles W. Gilmor e west The dinosaurs had more brawn than brain.


Pacific & Atlantic

ONE ACRE EQUALS THREE ACRES

At Daytona Beach, Florida, strawberries are being grown on the vertical plan, from the sides of stacked up crates This saves space, keeps the berries free from grit and gives the winter crop more sunshine Growers say this plan has made good


Wide World

LIQUID LENS LAMP

The lamp having a concave or dented end (note lamp held in man's hand), is immersed in a container filled with liquid. The concavity forms a condensing lens and throws a beam of light without the usual heat It will be used for projecting moving pictures and for other purposes

Keystone View Co.

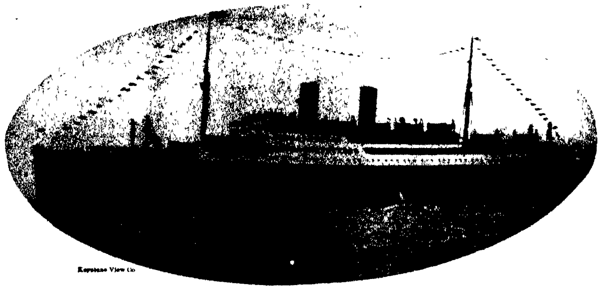
A NEW YORK SHERLOCK HOLMES

Edward J. Kelley, Jr., in charge of the laboratory of the Bureau of Criminal Science, which will analyze criminal suspects for the New York Police Department

Pacific & Atlantic

FORGERY OF FINGERPRINTS CLAIMED POSSIBLE

Milton Carlson, fingerprint expert, is shown here with a knife bearing alleged forged fingerprints of a man who has been dead six years. The knife is of recent manufacture


Keystone View Co

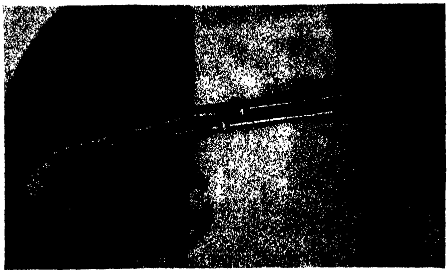
SHIP BURNS NO COAL

Driven solely by Diesel engines that consume low-grade oil, the new Swedish liner Gripsholm recently made her maiden trip to New York. She is 575 feet long, displaces 23,500 tons and carries 1617 passengers. Her speed averages 20.4 miles per hour The funnels are dummies

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins



Taking the thermometer out of the whirling case

Shaking down the mercury by centrifugal force

Thermometer for the Pocket

THE thermometer holder illustrated fits neatly into the vest pocket like a fountain pen. Instead of shaking the mercury in the thermometer down by hand (that is, instead of giving it several hard shakes) you simply pull on the two little rods shown. These are provided with threads like an automatic screw-driver, and spin the thermometer case around the shaft, shaking the mercury down to the bottom by centrifugal force. By pushing on the rods, they are closed up, and can then be closed along the side of the thermometer case.

You Cannot Spill This Blueing

BLUEING on a paper tape, as shown in the above illustration, will not spill. Neither will it freeze in the laundry some cold winter night and best of all there is no waste. The printing on the strip of tape shows just how much to use for a gallon of water.

Blueing by tape

A Safety Wringer

AN inventor from Springfield, Massachusetts, has devised a very ingenious safety feed and automatic stop for wringers. Wringers are prolific cause of accident, particularly where driven by power. Electrically operated wringers are now coming into quite general use. They are much used in combination with electric washing machines. It has been estimated that washing machines are now being fabricated by two hundred and thirty manufacturing concerns.

One of the illustrations shows an operator feeding clothes into the mechanism which carries them to the wringer rolls. The other illustration shows the operation of the safety device. If the operator's hand becomes tangled with the clothes which have been drawn into the wringer, the top roller and frame (being pivoted at the inner edge of the lower frame), will cause it to rise and push a horizontal, hinge-like, push rod that will in turn press a button on the automatic switch, thereby shutting off the motor before the operator's hand reaches the wringer rollers where the damage is done.

The device can easily be taken off one side of the wringer and shifted to the other side if wanted. Rubber screws keep the clothes from sticking to and winding around the wringer rollers.

Detail of the wringer stop, showing safety switch

If the hand is caught, the wringer stops automatically

Cleaning Carpets on Concrete

THE plant for the Hoboken District of the Pullman Company has a new concrete carpet platform, or rack, that is equipped with compressed air and vacuum through a syphon jet. This feature—the last word in cleaning—completes the carpet cleaning installation in the new yard. With this equipment the conditioning of cars can be carried on expeditiously and in a cleanly and satisfactory manner. The extremely cleanly condition of our parlor and sleeping cars is not attained without great labor and the most ingenious contrivances are used in the car itself to ensure sanitation.

Cleaning the Pullman carpets

Novel Radiator Cap and Alarm

THIS radiator cap illustrated is novel in three ways. First, it has a good appearance. Second, it is burglar proof. It is attached with a special wrench from the inside and cannot be taken off the car from the outside. Third, it has a novel whistle which is attached to the overflow pipe on the radiator. When the water and the motor get warm, this whistle will blow and warn of the danger and trouble ahead.

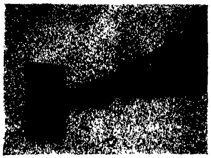
Radiator cap is secured from inside

Whistles when everything gets warm

This little kitchen is entirely in the open air, thus doing away with odors

Putting the Kitchenette Out the Window

IT is said that more than twenty million women in America swelter over cook stoves three times daily. That this is unnecessary torture is the claim of the inventors of a new type of stove, called the "save a room cookitchen." It is said that this stove actually saves a room, because it is built in a window or in a wall. The fumes from cooking pass outside. The invention is a sanitary and labor-saving one and offers maximum convenience and comfort to the housewife. It saves steps and the dread of hot days over a stove. The little kitchen is wired and lighted. It is made of metal and the panel over the doors inside the room is embossed to harmonize with interior furnishings. One type, a portable window kitchen, is especially built for light housekeeping apartments and for homes where gas, vapor, or electric plates are used. To install it, it is only necessary to raise the window, pass the kitchen through and screw it to the side casings. By closing the doors of this kitchen, the room can be kept cool during hot days.



Combined torch, soldering and branding iron

Blowtorch and Branding Iron Combined

AN interesting blowtorch and branding iron is illustrated on this page. It is used to brand trademarks and to brand the name of the owner on tools in construction work. The brands are all interchangeable and fit on the end of the gasoline torch as shown. A single burner torch burns from one and one-half to four hours without refilling.

Saving the old blades

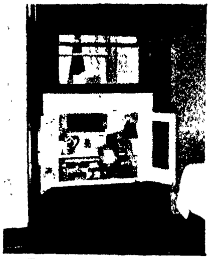
Protecting baby's milk with rubber buffers

Baby Bottle Protector

THIS baby-bottle protector is made of light weight aluminum in two fitted sections. It completely encases the bottle with several buffer strips of pure live rubber inside, to protect the bottle from jars and knocks when accidentally dropped upon the floor or any hard surface. The two sections are held together by two spiral coil springs easily slipped on or taken off. Breakage of the bottle is thus prevented, protecting the baby from broken glass. Since the bottle, thus protected, cannot be broken nor the nipple separated from the bottle, the device insures against loss of milk at inconvenient and embarrassing moments. It precludes the soiling of bedding, carriage covers, clothing and prevents the soiling of rugs, furniture or other things about the house. It helps maintain the heat of the baby's food for sometime, thereby making it ideal for traveling. It is sanitary and easily cleaned.

Safety hydrant prevents damage when sheared off

Doing away with carbon paper by substituting a ribbon



The outside kitchen exposed

Preventing Floods When the Hydrant Breaks

THE hydrant shown in our illustration is so constructed that it will not flood the street or damage property if, by accident, the standpipe is broken off or cracked. No water can enter the standpipe until the hydrant is operated by turning the main spindle.

Tongs With a Novel Twist

THE peculiar motion of the pair of tongs shown on this page is most fascinating and must be seen to be appreciated. They pick up anything and are especially useful where there is an open fire. They save the hands in many ways.

Tongs that save the hands

A Government Employe Saves Carbon Paper

THE Government was grateful to the extent of three hundred dollars to A. Eugene Melton, who invented a device for a typewriter which eliminates the necessity for carbon paper. In his invention, a ribbon takes the place of the carbon. The picture shows how the ribbon runs between three sheets of paper.

Razor Blade Stroppers

HERE are two razor blade stroppers which have special points of merit. Old blades which can be put into good cutting condition with but little effort should be saved.

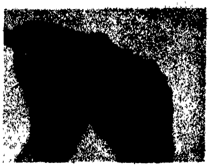
With these stroppers ordinary leather straps are used. A special guard prevents the edge of the blade from being rounded by careless stropping at the wrong angle. When through shaving replace the blade in the stropper, dry it quickly on your clothing and leave it there until the next shave, without danger of cutting the towels.

Another stropper for safety razor blades

Golf grip in the left hand

A Positive Grip for the Golf Club

VARIOUS devices have recently been introduced for enlarging the end of the shaft of a golf club in order to overcome the pull of centrifugal force They usually taper away from the hand and the increase of size is the same all around the shaft This means that the resistance and brace against the centrifugal drag is not sudden and positive enough, and worse still, that the swell of the big end comes onto the bulge of the muscle on the little finger side of the left hand, which throws the shaft out of the natural alinement it has with the normal finger grip Needless to say, in a game that calls for such mechanical accuracy as golf does, one cannot afford to handicap oneself in this manner Many of the great golfers thoroughly approve of the principle embodied in this invention. The illustrations show the position of the grip on the shaft



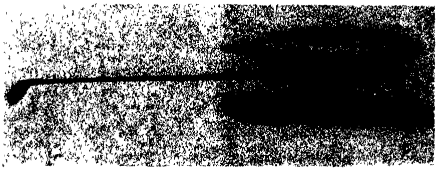
Grip at top of the swing

A new type of children's vehicle

Scales for Determining "Heft" or Balance in Handles

Finding out the leverage weight of ball bats

IN the clever scale designed by Mr P. A Vaile the well known writer on golf and tennis, each implement of sport is gripped in a special holder and the end of the holder is inserted beneath a hook attached to the base of the scale. The other end of the holder, representing an arbitrarily fixed fulcrum, rests in a hook attached to the scale beam By this means it is possible to determine with accuracy what we will call the "constant" of the clubs, indicated by the setting of the poise on the beam Our "constant" of the club is therefore a product of weight multiplied by inches Let us therefore choose the measure of weight as the pound and the measure of distance as the inch It is then easily within the scale-maker's art to graduate the beam of the scale so that the "constant" will be inch-pounds, which is a term defined in all text books on physics or engineering. Now we know something definite about that quality of the club which has heretofore been vaguely referred to as the "balance," the "hang" or the "heft" of the club. If it be desired to duplicate a club the constant of which was known, it is a simple matter to check the replacement club in this scale and then either load or trim as required.



Doing away with "feel" and "heft" by scales

Ascertaining the true leverage weight of a racquet

A New Form of Joy Ride for the Children

A NEW type of children's vehicle has been developed from what is known as the "kick-sledge," a means of travel well-known in Scandinavia This was merely a chair on long runners. A Swedish enginer has transformed this idea into a toy for children. A child standing with a foot on one of the foot rests in the rear and grasping the wide handles in the front gives a long shove with the free foot and thus starts the vehicle moving.

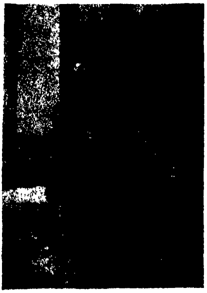
A toy inspired by the kick-sledge

A German Cart That Folds Up

ONE of our German correspondents sends us a couple of pictures of a collapsible cart which folds up into very small compass The left-hand illustration shows the folding mechanism of the bottom of the cart. First the wooden bottom is folded against the sides, then the framework is folded up. The folded cart is shown in the illustration at the bottom of this column.

A Novel Form of Household Tongs

A SHORT time ago a lady brought into our office an extremely clever pair of tongs with alternating sharp and dull teeth. With this pair of tongs an effective gripping action may be had without danger of the short teeth projecting through the article with which the device is engaged. The new tongs are very useful in the kitchen. We illustrate the tongs upright with an enlarged view of the teeth In the foreground is a large pair of brass lazy-tongs and lying on it is a pair of silver sugar tongs, both dating from the early part of the nineteenth century This group shows most admirably the progress of invention, from the purely decorative sugar tongs to the very useful tongs with the alternate teeth.



Expanding the collapsible cart

"Pom" tongs for use in cooking have coarse and fine teeth

How the cart is folded

The Scientific American Digest

Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

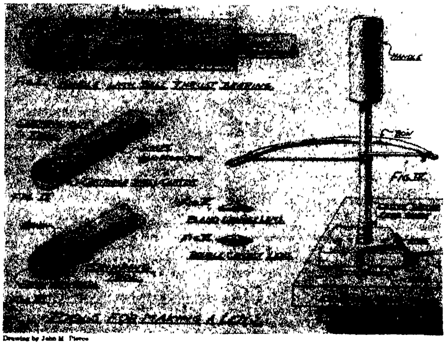
A Small Reflecting Telescope

To those who feel that the construction of the telescopes described in the February and March issues of the Scientific American, and in the book, "Amateur Telescope Making," (Scientific American Publishing Company, New York) is beyond their skill or patience, a small, simplified instrument having a spheroidal mirror four inches in diameter is described by John M. Pierce, of the "Telescope Makers of Springfield" It may, moreover, prove to be a stepping stone to the construction of a larger instrument.

The speculum or concave mirror was made from a piece of automobile wind shield one-quarter of an inch thick. This was ground and polished to a focal length of 24 inches, following substantially the directions given in the February, 1926, issue of the Scientific American, except that no attempt was made to parabolize its surface The latter simplifies the glass work, and while a spheroidal curve is only an approximation to the paraboloidal curve, which is perfect, it was found *on trial to give satisfactory results* The rings of Saturn and the bands and satellites of Jupiter *appeared beautifully clear and* distinct. It also proved to be a powerful terrestrial telescope If any improvement were to be suggested it might be the use of a thicker disk of polished, commercial plate glass, since assurance cannot be given that a thinner one will retain its figure and will not warp out of shape.

The speculum is held on a hexagonal wooden back by three screws, fitted with fiber faucet washers, which press it down upon three cushions, made by cutting ½-inch thick slices from a rubber sponge. Unless ½-inch glass has been used for the speculum the screws must not be tightened much, as this distorts thinner glass.

The diagonal mirror is made from a piece of ¼-inch plate glass and measures 1 x 1¾ inches. The ends are ground to a bevel by rubbing them upon a flat glass or iron surface with a medium grade of carborundum and water. They may be left square if desired. The diagonal mirror is silvered on its front face, following the directions given in "Amateur Telescope Making" The silver may be protected, like that of the speculum, with a thin coat of lacquer Set this mirror at exactly 45 degrees and directly over the eyepiece hole The center of the diagonal should be at exactly the same distance from the bar as the center of the speculum.



Drawing by John M. Pierce

A fairly good eyepiece for a telescope may be made at home

The eyepiece is made by removing one flange from a spool, enlarging the hole, and mounting a magnifying glass in it A lens of about one inch focal length is most satisfactory It may be held in the spool by *imbedding it in chewing gum* A lens of shorter focal length will give a greater magnification, one of greater focal length, a greater field with less enlargement

Lenses suitable for this purpose or for use as magnifying glasses can be made quite easily and accurately with very simple tools The best lenses are made from optical glass A broken spectacle glass will provide excellent material Ordinary plate glass from a broken mirror or automobile wind shield will be satisfactory

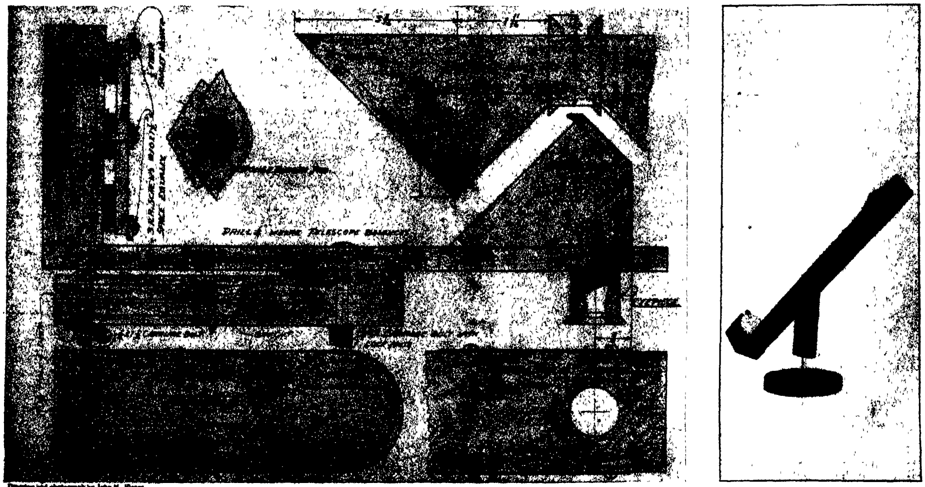
Cut out a bow (Figure 4, above) from a pine board, making it about 20 inches long with about one inch of curve String it with a piece of belt lacing, tying one end and having a hole in the bow for the other end of the string to be slipped through Make a wooden handle (Figure 1) by boring a 9/16-inch hole, 4 inches deep in a piece of broom handle Force a short length of brass tubing (or a cartridge shell with the end cut off) on one end of a piece of ½-inch solid dowel rod, 10 inches long (Figure 2) Let the tubing *project about ½ inch beyond* the wood

Place the glass on top of the bench and clamp upon it a piece of board having a notch to act as a guide for the cutter. Assemble the drill by dropping two half inch steel balls into the handle to act as a thrust bearing Insert the dowel after them, wrap the bow string around the dowel, draw the string tight and tie the loose end Hold the handle upright with the cutter resting against the notch and rotate by moving the bow back and forth Place a little carborundum about size 200, and water under the cutter

As you work, you will soon see a circular groove being ground in the glass which in a few minutes will be cut through, leaving a circular core This is the blank from which the lens will be *made* Cement it to the bench with a little melted rosin If it does not stick, wet it *with a little turpentine*

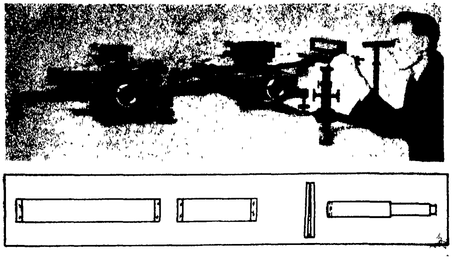
Fill your cutter with melted lead and press a ¾ inch ball into it while it is still soft, thus forming a spherical hollow (Figure 3) Using this with the bow, grind the lens with carborundum and water until it has an even, spherical form Swing the handle back and forth in order to even the grinding You will need no guide Reform the lead when necessary by pounding the steel ball into it When the glass is ground to shape, wash it off and repeat, using finer carborundum Finish grinding with the grade known as "60 minute"

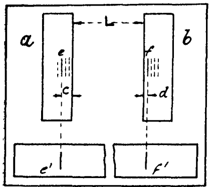
To polish the lens, melt and mix nine parts of rosin with one part of beeswax Knock out or melt the lead from the cutter, and fill with this *mixture* Before the pitch has hardened, form it with the ¾-inch ball, as before Polish with this *tool, using jeweler's* rouge instead of carborundum When



Drawing and photograph by John M. Pierce

The various parts of the mounting for the small, simple, four-inch reflecting telescope shown in the photograph at the right





Courtesy of Adam Hilger Ltd

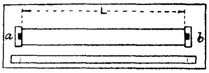
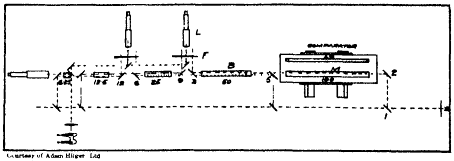


Figure 1. At top: the lame etalon or wedge film which compensates for any slight deviation in the optical length ratio of 2:1. Below the top illustration is a diagram which is analogous to it. In this column: how a one-meter etalon is compared directly with an invar bar. Note the fine lines engraved on the end plates. At left: detail of ends of etalon and invar bar shown at right, magnified



Courtesy of Adam Hilger Ltd

Above: how the length of the meter etalon may be calculated to 1 part in 10,000,000. Below: diagram of the process pictured above

polished, which will take several hours you will have a finished plano-convex lens (Figure 5).

If you want a double convex lens (Figure 6), grind and polish the other side. A smaller forming ball will give a greater magnifying power, a larger ball, a less powerful lens.

The *mounting for the telescope is made of* wood, but any attempt to give detailed instructions would merely be duplicating those given by the accompanying drawings and the photograph on the preceding page.

The distance from the front face of the speculum to the center of the eyepiece hole should be two and one-quarter inches less than the focal length of the mirror. Adjust the joints of the mount so that they move easily. Rubbing them with soap or paraffin will help. Paint all wooden parts a dead black color.

The base is made by fastening a ⅞-inch iron rod vertically in something heavy enough to support the telescope firmly. A gear from the scrap pile of a local machine shop furnished the base shown in the photograph. The rod is set in a wooden plug driven into the gear. A good base may be made by casting the rod in a concrete block. The telescope can be lifted from the base and taken indoors when not in use.

To collimate, or line up the mirrors, remove the eyepiece and put a round piece of cardboard having a ⅛-inch hole at its center, into the eyepiece hole of the bar. Looking through this you see the diagonal mirror and in it the reflection of the speculum. Bend the diagonal support until the speculum shows in the center of the diagonal. Next make a ⅛-inch ink spot upon the center of the silvered surface of the diagonal. Look through the hole in the cardboard again and you will see this spot and its reflection in the image of the speculum. Adjust the speculum by turning its three *retaining screws until the reflection of* the ink spot covers the spot itself symmetrically. Do not attempt to remove the ink spot. It does no harm and is ready to aid in checking the collimation of the instrument at any time.

* * *

Measuring Standards of Length by Means of Wavelengths of Light

THE first practical step in the accurate determination of standards of length was taken by Michelson and Morley who in making use of light waves, enabled a standard of length such as the meter to be measured with an error of not more than one part in ten million.

Before describing this apparatus a brief consideration of standards of length should show the necessity for its manufacture. In stating a length or distance in meters, yards, or other units, few give thought to the real meaning of these terms. To form a perfect standard, a selected length must be capable of expression as a multiple or sub-division of some distance to which it can be compared easily, and the latter distance must be *related to some unalterable phenomenon, unalterable* at all events, to our knowledge.

The English yard cannot be said to conform to this definition, since the existing *standard is a copy of authentic copies of* the Imperial Standard Yard destroyed in the fire which consumed the two Houses of Parliament in 1834. The United States possesses similar copies *of the* Imperial Standard Yard and also possesses two copies or "National Prototypes" of the meter, a number of which were issued from France to various countries in 1889.

In the United States the meter is now the fundamental unit of length and the yard is *defined as* $\frac{3600}{3937}$ *meters*. In the event of a difference arising between the Standard Yard kept in America and England, respectively, it would be difficult to determine which standard *had altered* and *the ratio stated* above would be of doubtful value. This, and other considerations, point to the necessity for measuring the Standard Yards in wavelengths *of light, as in the case of the* meter.

The meter originated in France at the time of the Revolution and received very *careful consideration*. It was intended to be equal to exactly one ten-millionth of the distance between the North Pole and the Equator, but it was not made accurately so. Therefore, as a readily *reproduceable* standard it was not much better than the Imperial Standard Yard. In 1889, at the "*Premiere Conference Generale des Poids et Mesures*," the meter was decided upon as the international standard of length. The original meter was replaced by an improved standard, which was adopted as the International Standard Meter. It is a bar made of platinum and iridium, and engraved upon it are two fine crosses. The distance between these crosses *at the temperature of melting ice* is defined as a length of one meter.

It was found, however, that in spite of all precautions some of the Prototypes, owing to *secular changes in the metal, altered in* length to the extent of as much as one part in two hundred thousand. These discoveries made it vitally necessary to devise a means of checking the constancy of the meter, and a method of doing this was suggested in 1889 by Michelson and Morley, who proposed to measure it in wavelengths of light. This was carried out by Michelson in 1892 and 1893, and again with different apparatus by Benoit, Fabry, and Perot in 1906.

Instead of specifying the meter as the length occupied by an exact number of wavelengths of light of a definite radiation—which would make an ideal standard capable of simple sub-division—the next best solution is to measure the meter in wavelengths of light, which may be considered unalterable in length. The importance of the original observations of Michelson, Benoit, Fabry and Perot may be estimated from the fact that all wavelengths of light are expressed in terms of the meter.

The Imperial Diet of Japan recently decreed that the meter, previously permissible only, should become obligatory as the only legal standard of length, but before this was done it was necessary to decide whether they should rely entirely on the Prototype in their possession. This was not considered sound procedure and, in view of possible loss and doubtful replacements, the final decision was to measure the Prototype with interferometric apparatus similar to that with which the International Prototype was measured in terms of the red cadmium light by Benoit, Fabry and Perot.

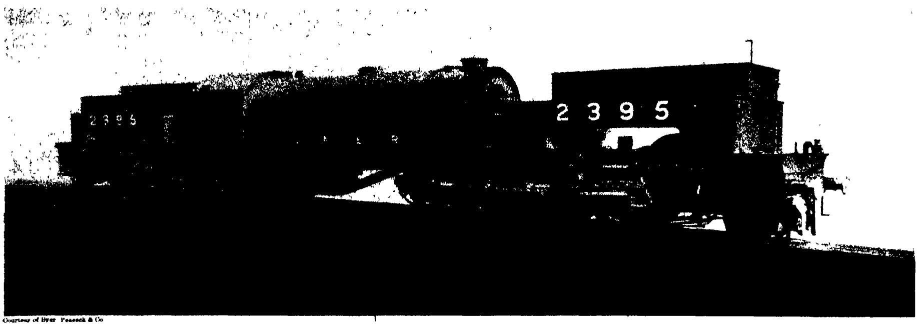
The apparatus for this, which needed to be of the highest possible accuracy (in order to give results correct to one part in ten million) was made by Adam Hilger, Ltd., London, England, and delivered in 1924. The apparatus does not deal directly with the National Prototype but with a bar of invar engraved with two lines, the distance between which to a high order of accuracy is one meter. This bar can be compared subsequently by meteorological observation with the National Prototype under precisely similar conditions of temperature.

The following short description of the more unfamiliar items of the apparatus will help the reader to visualize the processes followed in measuring the invar bar.

The Fabry and Perot Interferometer is an instrument by means of which two perfectly

Courtesy of Adam Hilger Ltd

Two-centimeter and one-centimeter mounts for the derivation of constant A'



Courtesy of Beyer Peacock & Co

The most powerful British locomotive. Built for assisting trains over grades of 2½ feet in every hundred. There are two complete engine units, each mounted in its swivelling truck. Each engine has three 18½-inch by 26-inch cylinders. The total weight of the locomotive is 398,804 pounds

plane mirrors, lightly silvered on their opposing faces, may be separated by any distance up to as much as 20 centimeters, without these faces losing parallelism

An etalon consists of a pair of lightly silvered, flat mirrors separated by a fixed distance, the mirrors being maintained perfectly parallel by suitable supports on a rigid mount.

The "Lame Etalons" or wedge films each consist of two perfectly flat glass strips, lightly silvered on the inner faces and separated at their ends by very thin tin foil, the foil at one end being thicker than that at the other. The strips and foil are cemented together, and the slightly tapered block thus formed may be moved in the direction of its length and about a vertical axis The thickness of the enclosed film of air is measured and calibrated in wave lengths of light

The largest etalon that of one meter length, is compared directly with the invar bar with the two lines, as shown in Figure 1 Close to the inner faces of the etalon plates *a*, *b*, are engraved a number of fine lines *spaced at 050 millimeter intervals in the* case of plate *a*, and at 054 millimeter intervals in the case of plate *b* By means of a comparator fitted with microscopes and micrometer eyepieces it is found that a line *e* (lower left hand cut of Figure 1) on plate *a*, and a line *f* on plate *b* coincide with the two lines *e' f'* on the invar bar with a maximum error of 002 millimeter which may be measured.

The method of measuring the optical length of the "meter" etalon relies on the fact that if two etalons having a ratio of optical length equal to 2 1 are placed in train and white light is passed through them, a number of colored fringes with a central pair of black fringes may be observed A slight deviation from this ratio may be compensated by a "Lame Etalon" or wedge film (described above) This arrangement is shown in the half-tone and cut at the top of Figure 1

Five etalons are used, the longest of which is nearly one meter in length, the others being one-half, *one-quarter*, *one-eighth* and one-sixteenth of this length within a few wavelengths. The five etalons are arranged in train and adjusted until the "white light" bands or fringes are obtained in turn through each adjacent pair In order to isolate each pair of etalons when required, suitable mirrors are placed in position, and in the course of the observations small differences from the ratio 2·1 are compensated by means of the wedge films

The shortest etalon, the distance between whose faces is nearly 6.25 centimeters, may be measured in terms of the red radiation of cadmium light. When the light is passed through an etalon a number of red and green rings may be seen, the measurement of which, in conjunction with observation made with the Fabry and Perot Interferometer, enable its optical length to be measured Thus, by knowledge of the exact ratio of the optical lengths of the five etalons, the length of the 'meter" etalon may be calculated to an accuracy of one part in ten million

The complete arrangement of the etalons placed ready for comparison is shown diagrammatically in Figure 2, bottom, and also in the photograph All the etalons are placed in a line and carefully adjusted so as to be accurately parallel The comparison can then be made quickly without moving any of them

If, for example, the etalon M, having a length of one meter, is to be compared with B, having a length of 50 centimeters, white light coming from X is reflected by the mirrors 1 and 2, and traverses M and B the mirror 5 being moved out of the way It is then reflected by the mirrors and passes through the compensating wedge film F, being finally observed through the telescope L

The method of deriving the optical length L (see Figure 1) of the "meter" etalon has *been described above The small distance* c and *d* at left, which added together are known as the constant A are measured by transferring the glass plates of this etalon in turn to two short etalon mounts of about one centimeter and two centimeters length respectively Comparison is then made of the engraved lines, *e*, *f* with a centimeter scale engraved on a short invar bar Observations made with a micrometer eyepiece enable the lengths *c*, *d* to be calculated with the same precision as the length L Thus the distance between the marks on the meter invar bar is measured in terms of wave lengths of light The invar bar is compared subsequently by meteorological observation with the Prototype under precisely similar conditions, the latter being absolutely under control

A bow view of the world's largest oil-engined ship

* * *

The Largest British Locomotive

THERE has recently been placed in service a British locomotive that is by far the largest and most powerful ever constructed in Great Britain, which embodies many novel features in its design It was built for the London and Northeastern Railway, for pushing service In this work it is as powerful as two or three helpers, which hitherto had been necessary in carrying coal trains weighing about 900 tons over a stretch of two miles, on which the grade has a rise of 2 5 feet in every hundred feet The total length of the run up grade is seven miles The locomotive weighs 398 804 pounds of which 322 308 pounds are carried on two sets of driving wheels, one at each end of the locomotive

As will be seen from the *illustration*, the engine consists of two distinct locomotive units Each of these has three cylinders, one on each side of the frames and one between the frames All the six cylinders are 18½ inches in diameter and 26 inch stroke The driving wheels are 56 inches in diameter The steam pressure is 180 and with 85 percent cut off a tractive force of 72 940 pounds is developed

Because the rails on English railways are rather light for a locomotive of this weight it was necessary in getting out the design, to pay careful attention to the distribution of the weight Hence as will be *noticed*, the load is distributed over a considerable length of wheelbase The maximum load on any axle is 44 093 pounds of which 158 984 pounds are on the front group of drivers and 162,324 pounds on the rear group

The front tender carries water only, for which it has a capacity of 2 800 gallons The rear tender has a capacity of 2,200 gallons of water and seven tons of coal

* * *

What Is Life? How Does Evolution Work?

IN the world of the biologist, two perennial and basic questions that have never been answered are what is life? and, are acquired characters inheritable?

Is life simply a chemico mechanical process some sort of a test tube phenomenon, pure and simple—or is it something more subtle something deeper more ungraspable? From these two considerations we get the two theories of the nature of life the mechanistic and the vitalistic

The other mooted question is are acquired characters inherited? "No" say the great majority of biologists 'they are not, because *there is no physical mechanism by means* of which they could be inherited Nevertheless a fairly large group of biologists maintain that acquired characters *are* inherited whether we can account for it or not Certain physical characters acquired during the individual lifetime of a parent animal are passed along, these biologists maintain, to the offspring If this could be proved, we would thereby have established the *method* by which evolution takes place, a thing which we have not as yet, however, found out

Both of these great questions involve or draw in with them many other important biological considerations and the whole matter is more ably summarized in Professor Seba Eldridge's new book "The Organization of Life" (Crowell) than the present writer has ever seen it done within a single pair of covers Professor Eldridge has his own theories concerning these questions but he presents all the extant theories impartially judicially

* * *

The World's Largest Motor Ship

UNDOUBTEDLY the outstanding fact in the development of the world's merchant marine is the rapidity with which the Diesel marine motor in its various modifications, is ousting the steam engine as the main drive for power driven shipping

Our illustrations show the latest and largest passenger motor ship, the *Asturias* built by Harland & Wolff for service between New York and South America She is a 22 500 ton ship and her dimensions

One engine of the twin-engined Diesel-oil ship *Asturias*, of 22,000 tons. It has a total horsepower of 20,000

Harris & Ewing

Taking a moving picture of a rifle bore, showing the tiny light and periscope and the camera containing the film

place her well up among the large steam driven passenger ships of the present day She measures 655 feet 8 inches over all; her breadth is 78 feet and her depth is 45 feet. She is a handsome vessel and shows all the distinctive characteristics of the modern Atlantic liner.

The ship provides accommodation for about 1,800 persons including passengers and crew She includes all those refinements which have been worked out in steam-driven vessels in the way of ventilation, hot and cold water supply, and means of recreation

It takes but a glance at our illustration of one of the twin engines to show to what mammoth proportions the marine motor engine has grown This view shows a complete unit as erected on the floor of the shop, and a striking impression of its size is afforded by the men who are seen standing on the four successive platforms that occupy the full height of the motor.

Each of the twin-screw main engines is designed to give a normal output of 7,500 brake horsepower or 10,000 indicated horsepower per shaft Each unit consists of eight cylinders, 33$\frac{1}{16}$ inches in diameter, the common stroke being 59$\frac{1}{16}$ inches The engines are designed to run at a service speed of 115 revolutions per minute.

* * *

The First Electrically Welded Steel-Frame Building

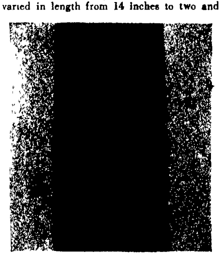
THE completion of a new, fifteen thousand dollar, two story-and-basement commercial building in the heart of the business section of Canton, Ohio, is considered to mark the assured acceptance of electric arc welding for joining members in the fabrication and direction of steel structures of certain types

The framework of the building was entirely electrically welded, both in shop fabrication and in erection Not a single rivet was used to join any of the various members of this heavy-duty building, which measures 100 by 150 feet in plan

The building was originally designed for rivets and, the change to welded connections, was made not to cut costs but to secure a more satisfactory job Moreover, welding not only provided 100 percent joints in place of 65 percent riveted joints, but there was an important saving both in money and in time

The decision by the construction company to substitute electric welding for riveting was based upon experimental and shop work Extensive tests made for many years were examined and a series of special tests were made which proved to the engineers' satisfaction, the superiority of the welded joint

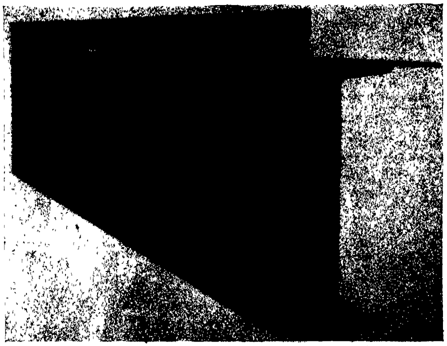
Three men operating "staple-arc" welders did all the welding in the fabrication of the structural steel, and a total of 14,694 linear inches of welds went into this operation, which was completed in 80 percent of the time which would have been necessary had riveting been used The total number of welds made at the plant was 4,171, which varied in length from 14 inches to two and a half inches In addition to the welding work at the shops, 780 welds were made on the job after erection One operator made a total of 4,294 inches of welds in 120 working hours



Lower shelf angle, as welded to column, on which girders are fitted

Tests have shown that two linear inches of $\frac{5}{16}$ inch welding bead equals the shearing strength of a ¾-inch rivet; but two and a half inches was adopted as a standard length, equal to a ¾-inch rivet in shear Actually, on the Canton job most of the welds are three inches long.

The architects point out that in designing structures for welding, in the future, it will be possible to simplify considerably the structural work over the requirements for a riveted structure; since the connections could be made much less complicated than those necessary in riveted work.



This view shows wall support flanges welded to spandrel beam

* * *

A New Way of Examining the Inside of a Rifle Barrel

BY means of an ingenious new device not only is it possible to obtain an accurate image of the entire inside of a rifle barrel, but the impression of it is recorded automatically on a motion-picture film for future reference.

This new camera is the first apparatus ever designed which makes possible the photography of the whole interior surface of a .30 caliber rifle barrel, with the impression recorded on a moving film. This development is to be credited to I. C Gardner and F A. Case of the Optical Instrument Section of the Bureau of Standards, and the invention is especially valuable to the United States Army in studying the wearing qualities and other characteristics of the different kinds of steel which are employed in the manufacture of various rifles

The principal parts of this camera consist of a tube or periscope about 30 inches long, an electric lamp supported by a tube inside of the rifle barrel, by means of which the picture is taken, a prism which reflects the image down the 30-inch periscope or photographic tube, and a photographic film taken from a motion-picture camera At present this elongated camera is operated by hand but eventually it will be hitched to a small electric motor.

As the rifle barrel moves back and forth along its appointed course or track the motion-picture film moves at a corresponding speed. This synchronism of the movements of the gun barrel and photographic film obviates any blurring of the image which otherwise might be caused by the motion of the rifle barrel The film-moving mechanism and barrel are connected by means of gearing Conventional rolls or spools are provided upon which the moving-picture film is wound

All rifle barrels, of course, wear out after continuous use over a considerable period of time Some barrels, however, withstand the effects of firing for a longer time than others, due to the kinds of steel employed The new camera will not only serve the purpose of determining the course of wear of rifle barrels, but by observing the behavior of different rifle barrels in service the United States Army will be enabled to choose suitable steel for the manufacture of small firearms This camera scrutinizes the interior of a rifle barrel with the same fine accuracy that an X ray machine reveals a defect in the human body

Those who have served in the army infantry will appreciate with amusement how a device of this sort recently threw a company of the National Guard into dismay. This company, a peacetime organization, had cleaned its rifles for annual inspection, and though the men had labored hard in an effort to present immaculate rifle bores to the inspecting officers, they had anticipated that he would inspect the bores only in the usual manner of the past—that is, by holding them up to the light and squinting through them for ten or twelve seconds

They were considerably dismayed, therefore, when this officer put in his latest annual appearance armed with a rifle bore periscope. Since this brought his eye into a far better position to inspect the rifle bores than it would be when simply looking down them in an almost parallel direction, he was able to find large accumulations of foreign matter that had eluded the eyes of the infantrymen. In short, this infantry company received a very low score on cleanliness of rifle bores.

The defender at the gates. Defective raw material "shall not pass" this alert tester. One reason why telephones are made right.

The acid test. The coating on a telephone must prove that it can resist corrosion.

A machine instates the hand, lifting and replacing a telephone receiver. An endurance test

"They shall not pass—"

WITH this watchword of determination the French held back their foe at Verdun. Today "they shall not pass" is a watchword equally determined in Western Electric telephone making—only here it always means "defective materials and apparatus shall not pass."

Inspection, inspection, inspection is the order of the day in this work of making telephones and telephone equipment.

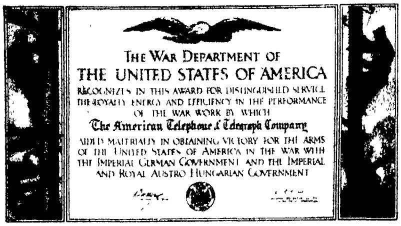
From the raw material stage, when strength tests and quality tests are rigorously applied, through every step of manufacture, a telephone must qualify for service—and do so before a chain of critical inspectors.

This insistence on high standards of materials and workmanship is Western Electric's day-to-day part in making Bell telephone service the standard of the world.

Back of your telephone

Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM



THE WAR DEPARTMENT OF
THE UNITED STATES OF AMERICA
RECOGNIZES IN THIS AWARD FOR DISTINGUISHED SERVICE
THE LOYALTY ENERGY AND EFFICIENCY IN THE PERFORMANCE
OF THE WAR WORK BY WHICH
The American Telephone & Telegraph Company
AIDED MATERIALLY IN OBTAINING VICTORY FOR THE ARMS
OF THE UNITED STATES OF AMERICA IN THE WAR WITH
THE IMPERIAL GERMAN GOVERNMENT AND THE IMPERIAL
AND ROYAL AUSTRO HUNGARIAN GOVERNMENT

Telephone Preparedness

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Fifty years ago Alexander Graham Bell, the inventor of the telephone, gave to the world a new art. He had the vision of a nation-wide telephone system by which people near at hand and far apart could talk to one another as if face to face. He foresaw a usefulness for the telephone which could not be achieved without innumerable developments, inventions and improvements, to him unknown. But not even he foresaw the marvelous applications of telephony which gave to the American armies that fighting efficiency which is possible only when there is instant exchange of complete information.

Since the completion of its service in time of war, the Bell System has devoted itself to the extension of the telephone art as one of the great agencies for the development of the pursuits of peace.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
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BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

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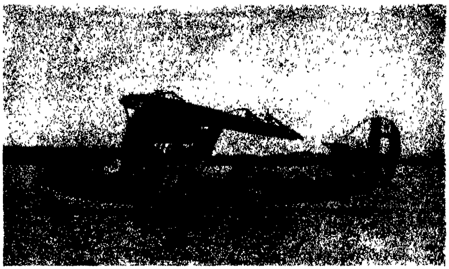
Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics



© Keystone New York

The English Electric Company's seaplane. As in the Dornier, the lower wing becomes a part of the hull as far as prevention of rolling in the water is concerned

No Wing Floats

A FLYING boat however broad its hull may be needs wing tip floats to protect the tips of the wings from the water when the seaplane rolls from side to side These wing tips are quite effective, but they increase the resistance of the seaplane without contributing in any way to the lifting capacity of the wings Both German and English designers have therefore sought to dispense with wing tip floats

The German Dornier plane *Pacifico* (which recently landed at Palm Beach Florida, after travelling 4000 miles from Colombia, South America) is really a monoplane, but, instead of wing tip floats, wing stubs are placed on either side of the hull These are metal covered, can resist the impact of the water, and effectively increase the rolling stability of the hull yet they provide lift and therefore do not diminish the aerodynamic efficiency

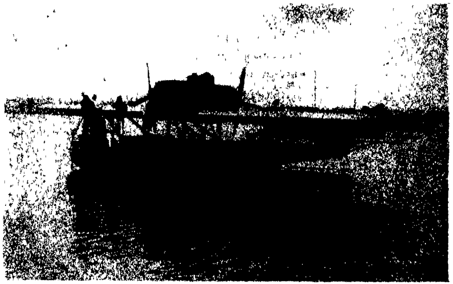
A new English method of dispensing with wing tip floats is really no different from that of the German design The lower wing of the English Electric Company's seaplane (shown in our photograph) acts as a lateral stabilizer for the hull in precisely the manner as do Dornier's wing stubs.

Dornier's plane is not new. A seaplane of the same type was used by Amundsen in his Polar flight But the photograph makes interesting study nevertheless The two tandem engines (which give a maximum of security against power plant failure) are beautifully streamline in their single nacelle The whole construction gives an impression of great solidity There should not be much danger of the engine mounting giving away and the engines landing on top of the occupants even in a very bad landing The wing stubs from the hull not only increase its rolling stability but also serve to anchor the wing struts and relieve the upper wing of some of the air forces acting on it.

A Mystery Bomber

THE Huff Daland Airplane Company are building a new bomber for the Air Service which is still kept somewhat of a mystery by the Intelligence Service Such information as has been issued is interesting. The *Cyclops*, as the new plane is termed is perhaps the largest single-engined bomber ever built Its engine must develop at least 700 to 800 horsepower Fully loaded it will develop 135 miles per hour, and with a gross weight of 17,000 pounds it will carry a useful load of 9,000 pounds This in itself will be a great achievement For a plane to carry over 50 percent of its gross weight in useful load is something we have scarcely heard of before. If such a useful load is indeed available, then the company's statement that the plane will have more than sufficient fuel

(*Continued on page 264*)



Acme

The Dornier flying boat *Pacifico* which recently flew from Colombia, South America, to Palm Beach, Florida. The cleverly designed wing stubs eliminate the necessity for wing tip floats

American Blower

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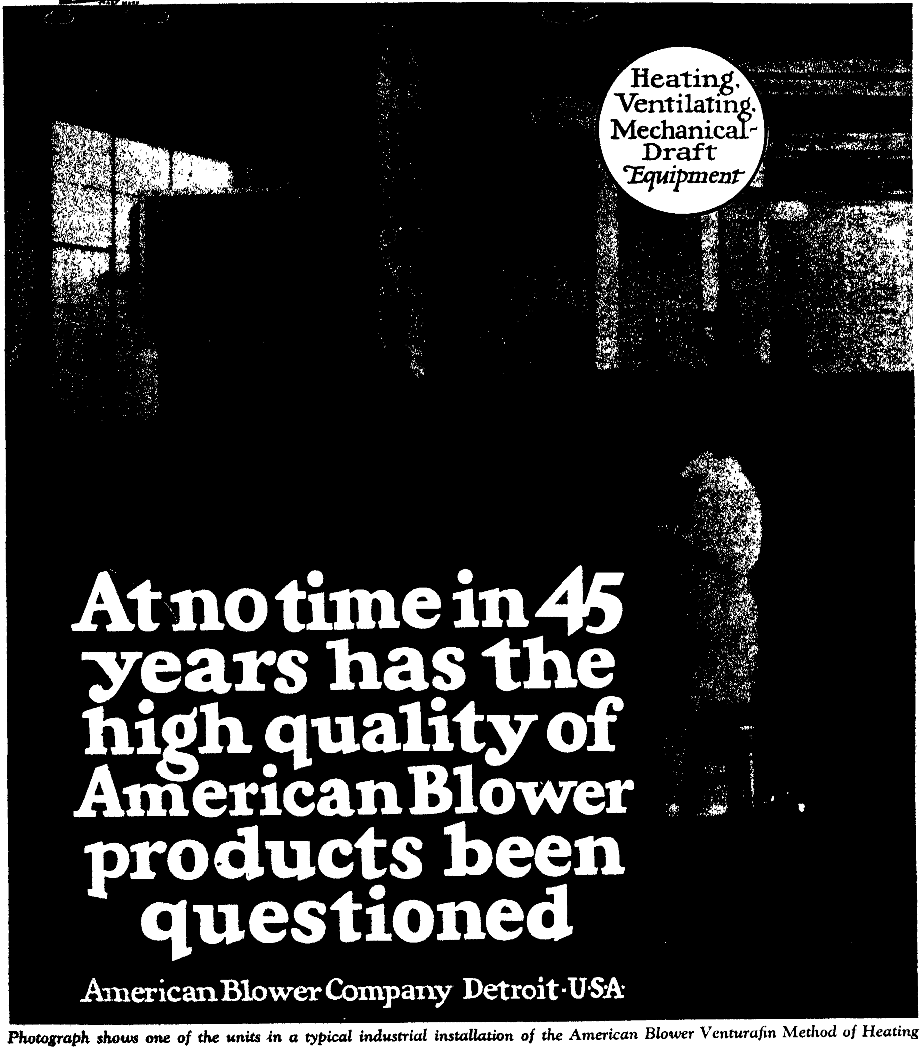

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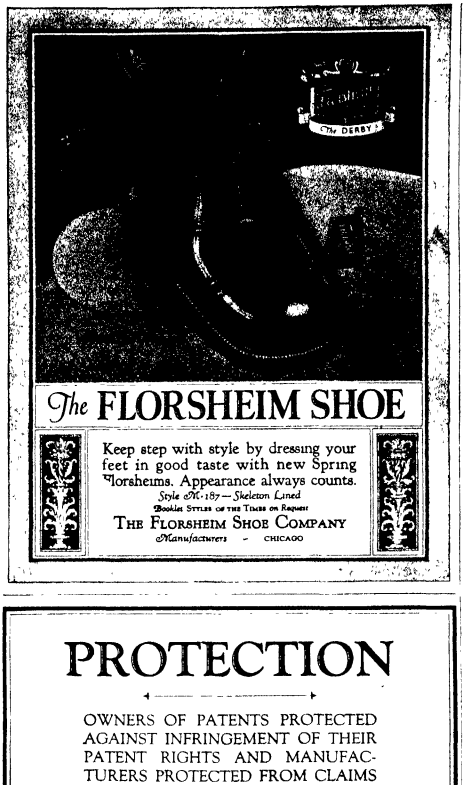
Photograph shows one of the units in a typical industrial installation of the American Blower Venturafin Method of Heating



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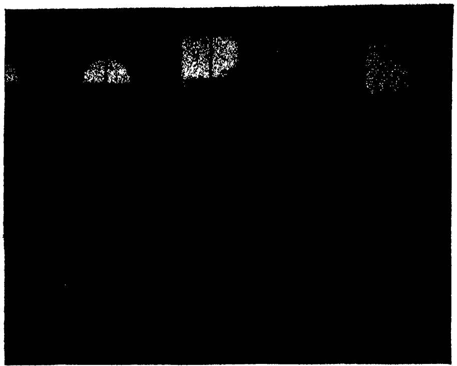


Wide World

Welding is being used widely in airplane construction, as in this fuselage of the *Cyclops*. A bomber must be protected from the rear. The gunner, standing up, can direct his guns in almost every direction

for a non-stop flight from New York to London is entirely credible

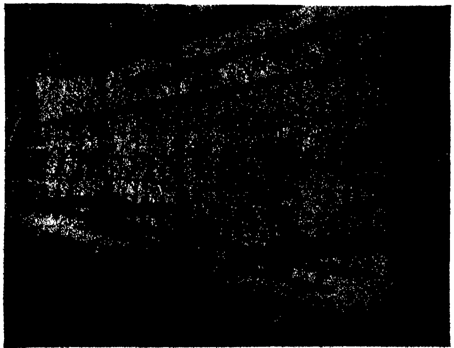
The British Air Ministry has recently announced that it will discard wood construction in all its new construction, and that five years will see the British air fleets built entirely of metal From the photographs of the *Cyclops's* construction, with which this note is illustrated, it would seem as if our Army Air Service were adopting the same policy There is not much wood to be seen in the photograph of the giant wing, not yet covered with fabric so that the entire internal construction is visible. The two main girders of the wing, or spars as they are called by airplane designers, are made of seamless chrome molybdenum steel, which under certain conditions of heat treatment develops a strength of 200,000 pounds per square inch, or nearly four times as much strength for a given cross-section as the mild steel that goes into our boilers or skyscrapers

The wing girders are built up in exceedingly simple fashion. Two long tubes, running the whole length of the wing, constitute the upper and lower "flanges" of the wing girder Short tubes of the same material, welded to the top and bottom beams, constitute the girder webs. Nothing easier in manufacture or assembly is imaginable. The wing ribs, which are parallel to the line of flight and transverse to the wing girders, are evidently of duralumin, and are also of good constructional form. Those ribs transfer the lifting power of the air on the fabric to the wing girder and also serve to maintain the aerodynamic contour of the wing. Airplane designers are now learning to build these ribs with the utmost lightness. A huge rib of some 15 feet in length will weigh only 20 ounces and yet resist a total load of hundreds of pounds when tested to destruction

Perhaps this is an age where welding will largely displace riveting as a method of fastening metal to metal. We hear of welded boilers and even welded ships. In the *Cyclops* not only are the wing girders welded, but the entire fuselage likewise, as can be clearly seen from the first of our photographs, where the lengthy longerons and the shorter tubes—top, bottom and sides—are all welded together without the use of a single rivet.

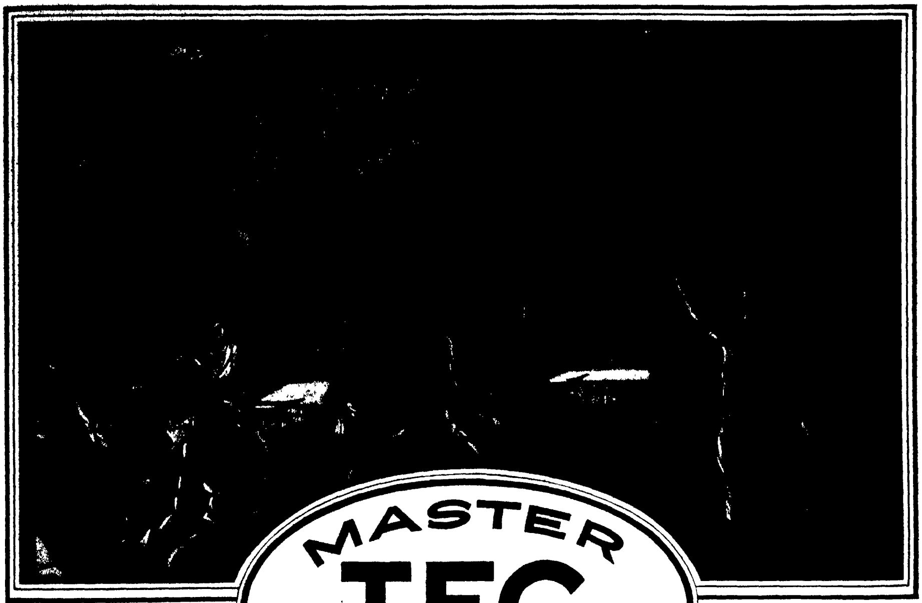
A bomber is primarily an aircraft which can throw bombs on the enemy, but it must be able to defend itself from attack by agile single-seater fighting ships. It must have guns to sweep the sky in all directions. Hence the provision of very carefully de-

(*Continued on page 266*)



Acme

The all-metal wing of the new bomber *Cyclops*. The very simple wing girders are welded of seamless chrome-molybdenum steel of enormous strength. The transverse ribs of duralumin are strong and light



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A booklet, "Sheet Steel Service to the Public," mailed on request.

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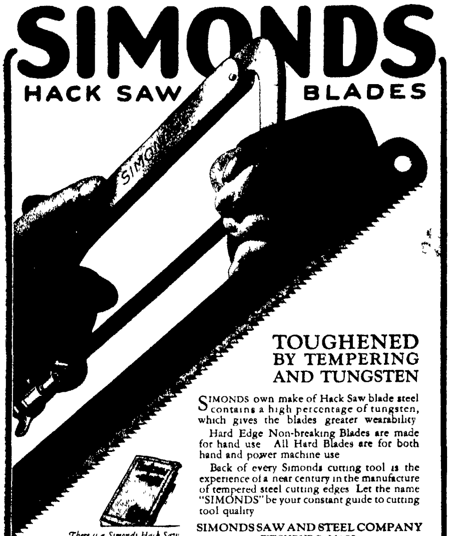
SIMONDS HACK SAW BLADES



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Hard Edge Non-breaking Blades are made for hand use All Hard Blades are for both hand and power machine use

Back of every Simonds cutting tool is the experience of a near century in the manufacture of tempered steel cutting edges Let the name "SIMONDS" be your constant guide to cutting tool quality

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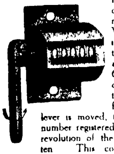
FITCHBURG, MASS
"The Saw Makers" *Established 1832*
Branch Stores and Service Shops in Principal Cities,

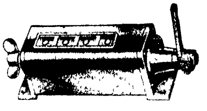
Must be Driven to Destination

The machine without a *record* to make, runs with no destination. With no *production*-goal, there's no real drive in development or in operation. You get results when you set a mark—a standard *task*—for output. Indicated, and watched to completion, by a

Veeder COUNTER



This Small Rotary Ratchet Counter (No 6) counts reciprocating movements of the lever, as required for recording the output of many small machines When the lever is moved through an angle of 40 to 60 degrees, the counter registers one The further the lever is moved, the higher the number registered A complete revolution of the lever registers ten This counter can be adapted to no end of counting purposes, by regulating the throw of the lever Price, $2.00 (*Cut nearly full size*) Small *Revolution* Counter of similar model, also $2 00.



This large **Re-Set Rotary Ratchet Counter** records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round Provided with from four to ten figure-wheels, as required Price with four figures, as illustrated, $11 50 (List) Equipped with lock and keys to prevent tampering with the record, $2 00 extra (*Cut less than half size*) Set-Back *Revolution* Counter, $10. (List)

The Veeder booklet will show you counters to register increased production at ANY machine Sent free to all who may meet with the problem—in invention, engineering or manufacturing.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

Pacific & Atlantic

Figure 1: R. J. Munkittrick, left, aviation chief rigger, and Lieut. B. P. Donnelly under whose direction Russell chutes are being tested. Note twists in lines. Chutes dropped in this fouled condition open almost upon leaving plane

signed gun-turrets at the rear of the airplane The gunner, if standing in the rear gun emplacement, can with a few movements direct his two guns almost perpendicularly down the sides of the body of the airplane, can swing his turret round in a circle or fire his guns upwards at any angle Almost as much ingenuity is exerted by aircraft designers in securing the greatest area of unimpeded fire as in building the structure of the airplane itself

A Novel Parachute

IN experience with the standard Army Air Service parachute, it has been found that no mechanism is necessary to open it Once the rip cord has been pulled and the fall has become rapid, the air is trapped in the top of the chute into a compressed ball which rapidly increases in size and forces the chute out Army parachutes are rendering the greatest possible service Their drawbacks are that they require skilful and careful packing, that they can be designed as a rule to open only after a fall of at least two seconds or something like 60 feet of free drop, and that entanglement of the shroud or supporting lines during packing is a source of danger

J M Russell, formerly of the Engineering Division of the Army Air Service, claims to have invented a chute which is free of all these objections. The Russell parachute is novel in that it is fitted with a series of valves placed along the entire wall of the chute, which permits intake of air along its entire length instead of at a bottom opening only

It is claimed that the Russell chute is useful for a drop from an altitude of as low as 100 feet, that the entanglement of the shroud lines is not to be feared, and that the chute can be packed without any special care

Figure 1 shows the chute with lines twisted thoroughly, yet tests, with the lines in this condition, have been completely successful In Figure 2 the men at the right of the photograph are indicating the air valves which are placed at various points along the chute.

Jet Propulsion

FOR a hundred years, perhaps, boats have been propelled in shallow waters by pumping water from the stream to the top of a tank, and then allowing it to escape at a fair rate of speed from the bottom of the tank, in a narrow jet The reaction of the escaping jet was sufficient to drive the boat forward, even though the efficiency of the

(*Continued on page 268*)

Pacific & Atlantic

Figure 2: This illustration shows series of valves placed along the entire wall, which allows intake of air. No center valve is used which is different from all other chutes. Russell claims that center valve allows outside pressure to close chute or keeps it from opening. With his chute the air gets in and holds the wall open, as there is no outlet in the center

Do you do this, too?

THEY'RE very strict in the police department at inspection time. And this officer's problem used to be watching his coat collar—dandruff.

Not any more, though, because now he's learned a way to correct it. If you're troubled the same way you'll be glad for this suggestion.

* * *

The unsightly "white coat collar"—showered with dandruff—is rapidly going out of style.

And the way to correct it is a very simple one. Just mark down the following statement as a fact.

Listerine and dandruff do not get along together. Try the Listerine treatment if you doubt it.

Just apply Listerine, the safe antiseptic, to the scalp. Generously, full strength. Massage it in vigorously for several *minutes and enjoy that clean,* tingling, exhilarating feeling it brings.

After such a treatment you know your scalp is antiseptically clean. And a clean scalp usually means a healthy head of hair, free from that nuisance—and danger signal of baldness—dandruff.

You'll thank us for passing this tip along to you. It's a new use for an old friend—*Listerine—Lambert Pharmacal Company, Saint Louis, U. S. A.*

LISTERINE —*the safe antiseptic*

A CHALLENGE

We'll make a little wager with you that if you try one tube of Listerine Tooth Paste, you'll come back for more.

LARGE TUBE—25 CENTS

for while the lower grades of HARD MAPLE are increasingly used for heavy-duty crates and boxes, **HARD MAPLE** in the better grades serves a multitude of practical uses in every industry. The superiority of climate-hardened, slow growth Northern **HARD MAPLE** for industrial flooring is, of course, well known to every factory executive.

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Greater strength, less weight Ability to stand strains and hard knocks. Better screw-holding and nail-holding power. Resistance to severe wear and shrinkage.

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THE HARDEST HARDWOODS GROW IN THE NORTH

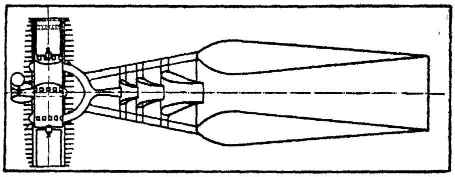


Diagram of Melot reaction engine for airplanes

mechanism was poor. The system has also been employed on lifeboats, where in exceedingly rough water neither oars nor a screw propeller give assurance of propulsion. Is it possible that the principle of jet propulsion may be applied to the airplane? We read in the *London Engineer* and in *Automotive Industries* that the French *Service Technique de l'Aeronautique* is testing out an airplane power plant invented by H. F. Melot which is based on the principle of jet propulsion, the energy of the gas being converted directly into propulsive effort without the intermediary of connecting rods, crankshaft and screw propeller.

The latest form of Monsieur Melot's invention is shown in diagrammatic form. If gas under high pressure after combustion were allowed to escape from a chamber in a narrow jet, its velocity would be tremendous Now the reaction of the gas would be proportional to its mass and *to its velocity of exit* The kinetic energy of the gas would be proportional to its mass and *to the square of the velocity* For a jet issuing with great velocity, the reaction would be small as compared with the tremendous loss of kinetic energy at exit. *To improve the efficiency* of conversion, the gases of combustion must be mixed with air inside the apparatus, so that the speed of discharge is decreased while the mass of the discharge is increased. This explains the presence of the four air injectors shown in our *diagram*. The exhaust gases pass from the combustion through a pipe and meet four air injectors each somewhat larger than the preceding one. Each injector draws in a larger quantity of air, so that finally a mass of air and gas emerges at a relatively slow speed.

Monsieur Melot started his experiments five years ago. Even at that time, he understood the necessity for the air ejectors. But in his early work, he simply burned kerosene in a combustion chamber lined with fire brick This was exceedingly simple, but the kerosene, not being compressed before ignition, could not develop the high pressures and the combustion efficiency of the internal combustion engine

The latest form of the Melot reaction engine embodies what is really a two-cycle, internal combustion engine. The new device consists of a horizontal cylinder inside which there are two walls forming a chamber. In each wall there is a spark plug for starting the engine with gas injected under pressure. There are three series of annular ports, the central orifices placing the carburetor in communication with the chamber, and the end ports being in communication with the exhaust pipe which leads to the first air injector.

Inside the cylinder is a piston which moves freely from one end to the other. It has concave faces and sleeves with ports corresponding with those in the cylinder. It is started by injecting the gas mixture under pressure and igniting by one of the spark plugs. Subsequently the speed of the piston is sufficient to raise the pressure of the gas to the point of self-ignition and the engine continues to run without the compressor and the spark plugs. The piston sleeves are arranged to open the exhaust ports at such a point as to ensure the burnt gases entering the exhaust pipes at the highest velocity

No information is as yet available as to the exact efficiency, although this is said to be satisfactory, and for every two pounds of weight of apparatus one horsepower is developed

American investigations on the subject have put in doubt the possibility of obtaining any great efficiencies, but for exceedingly high-speed planes the simplicity of the apparatus and the elimination of the propeller lead us to think that further developments are worth watching.

Wind Tunnel Models

OUR photograph has a double interest. It shows us Commander John Rodgers, U. S N., who was in charge of the Hawaiian flight last autumn and who has now taken over the duties of Assistant Chief of the Bureau of Aeronautics in the Navy. And it also shows us some beautiful wind tunnel models of navy seaplanes, used for testing in the aerodynamic laboratory the efficiency and stability characteristics of the full-sized plane Since even a slight change in the contour of the wing may induce an important change in its aerodynamic characteristics, these models, particularly as regards their wings, have to be made with exceeding accuracy. Sometimes intricate model wing

Wide World

Commander John Rodgers, in charge of the Hawaiian flight last autumn, examining a couple of beautiful wind tunnel models of navy seaplanes shapes in metal are made so accurately as to be right within 1/1000 of an inch. There is nothing in the model maker's art to equal this accuracy, not even in the construction of yacht models, formerly considered its crowning achievement.

Our New Automatic Safety Code

THE International Convention for Air Navigation held at the same time as the peace negotiations at Versailles (October, 1919) laid down definite rules and regulations for aerial navigation. The United States alone of all the great powers has failed to ratify this convention, whose adoption has greatly increased the security of flight in Europe, Canada and South America Since there has not been enacted in the United States any Federal legislation in regard to air travel, American flying is almost completely unregulated. And unregulated flying may be dangerous to the public and the fliers alike. It is therefore very satisfactory to see the Society of Automotive Engineers, the Bureau of Standards and the American Engineering Standards Committee collaborate in producing the Aeronautic Safety Code, which covers every phase of aircraft operation: structure, power plant, equipment; signals; airdromes and airways; traffic rules; qualifications for airmen, and so on.

While this code is not mandatory it will be of great utility in acquainting operators and the public alike as to what should be done to promote safety. A boiler safety code, or a code for testing steam engines no longer offers much romantic interest But the Aeronautic Safety Code in spite of its formal presentation still contains paragraphs that appeal to the imagination Some of them follow:

Kadel & Herbert

An acetylene lighthouse has been installed at the London Terminal Airdrome, at Croydon, which automatically lights up when the sun sets, and goes out as the dawn breaks to daylight conditions. The small valve which controls the light is contained in the glass cone on the right-hand side of the lighthouse

"The whole control system shall be so arranged that it is impossible for it to jam in any part as the result of any conceivable sequence of movements." We can readily imagine the feelings of a pilot who finds his controls jammed.

"The control mechanism shall be arranged *so that it cannot be jammed by loose objects* inside the fuselage, baggage under the seats, the clothing of a pilot or passenger. . . ." We can remember one accident where the rudder bar was entangled in a lady's moderately long skirt, with fatal injury to pilot and passenger alike.

We always think of flying as an open air proceeding, yet in an enclosed cabin passengers may be very greatly discommoded by lack of ventilation and the presence of gasoline fumes. The Code insists on 700 cubic feet of fresh air per hour for every passenger.

Nothing is so terrifying as fire in the plane and yet, with simple precautions, the danger

Quantity Production—the Governing Power of Costs

TRADE NORTON MARK

Norton electric furnace abrasives are trademarked "Alundum" and "Crystolon."

Norton Grinding Machines for grinding cylindrical work include types for crankpin, crankshaft, camshaft, car wheel and roll grinding.

"Alundum" and "Crystolon" trademarks also represent bonded refractory laboratory ware, heavy refractories, cements and porous plates.

Norton Floors include Alundum floor and stair tile, mosaics, treads and aggregates. All are non-slip.

But for quantity production countless modern conveniences would be luxuries at prohibitive prices.

Today there is a motor vehicle for every sixth person in the United States. Quantity production has made this possible.

This is a machine age—an era of rapid, accurate, economical adaptation of natural products to the needs of mankind. It is an age of precision in quantity production at low cost made possible by the art of Grinding. Not the humblest machine shop in the industrial world can operate without Grinding.

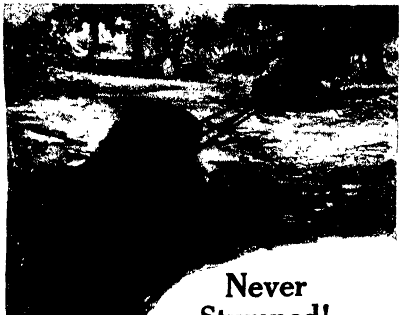
High and uniform production and low costs came with the discovery and development of electric furnace abrasive materials, the perfection of the grinding wheel and inventions of grinding machines—now essential tools of industry.

Norton Company

WORCESTER, MASSACHUSETTS

New York Chicago Detroit Philadelphia Pittsburgh

Bauxite Plant—Bauxite, Arkansas *Abrasive Plants*—Niagara Falls, N Y., and Chippawa, Ont
Grinding Wheel Plants—Worcester, Mass.; Hamilton, Ont; La Courneuve, France; Wesseling, Germany



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Great strength and long life are inherent virtues of Yellow Strand Wire Rope—the virtues that make for economy and the satisfaction that results from service well rendered

You can't stump Yellow Strand with hard work, nor with heavy duty

The wire for this unusual rope is especially imported—and one strand is painted Yellow to protect you

In addition to Yellow Strand Wire Rope, this pioneer manufacturer also makes all standard grades, for all purposes.

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Carry a Basline Autowline in your car and safeguard your spare tire with Powersteel Autowlock Both are made of Yellow Strand Ask your accessory dealer.

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Western Office Seattle Factories St Louis and Seattle
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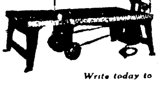

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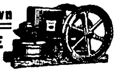

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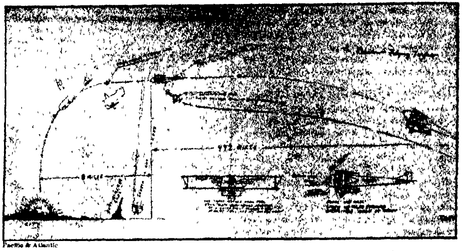


Pacific & Atlantic

Artist's sketch of the manner in which the Barlow Flying Torpedo functions

of fire may be almost completely eliminated The Code has some very wise rules on the subject of fire prevention Gasoline tanks are to be located as far from the engine as practicable, if possible on the wings and not in line with the engine All tanks must be so constructed as to withstand shock vibration and distortion A fire wall sheet steel with asbestos backing, must separate the engine completely from the rest of the fuselage or nacelle There must be no inflammable fittings in the cabin Air intakes of the carburetors must open completely outside the engine cowling so as to eliminate the danger of back-fire igniting a collection of gasoline vapor under the cowling These precautions are simple, but, alas, not always followed.

Landing gears on new designs are to be dropped from heights of almost three feet to test their strength or at least designed to withstand such severe impacts

Airdromes must have wireless, beacons, and so on

Collisions seem almost impossible in the air, yet they have happened. The Code defines right of way as carefully as the traffic regulations of New York City

Altogether the Code is a mine of simple and useful information and rules and its study by operators will do a great deal to make American flying safer

A Curious Suggestion

THE Barlow Flying Torpedo seems to have aroused interest in Congressional circles and the idea is a curious one Therefore, we feel justified in describing it, with many reservations as to its practicability The torpedo really constitutes the fuselage and tail surfaces of a large twin engined airplane with a long range of flight Rigidly fixed to this twin engined plane and below it, is a small pilot plane The pilot controls the large machine by electrical devices, can release his own craft at a certain point and also times the release of the torpedo from the rest of the structure of the large airplane From the time of its release the torpedo is to be controlled by gyroscopic devices. Perhaps the two sketches give a better idea than our description of the principles and functioning of the device. The pilot plane on the outward flight draws its gasoline from the main tanks, and therefore need only carry sufficient fuel for its own return journey

Here are a few of the objections which immediately come to mind·

The inventor claims a range of 1,000 miles on the outward journey for his device. The lone pilot has to have extraordinary powers of endurance to fly unaided a distance of 2,000 miles

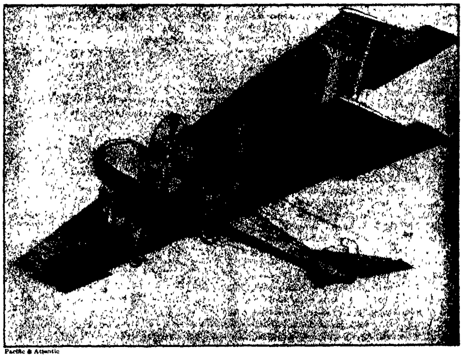
It is easy to speak of electrical devices controlling the large machine, but it is not so simple to control even the ordinary twin-engine airplane for one man, and there would be quite a number of electrical and mechanical complications to overcome

If the torpedo is to fly a thousand miles, part of the time there will be no sheltering darkness, and at such time the craft would be entirely at the mercy of enemy scouts—it would not have the multiplicity of guns and gunners which a bombing plane always carries

The launching of every torpedo would mean the loss of a plane and valuable motors, in contradistinction to ordinary bombing operations where the bomb alone is launched

In ordinary bombing operations, given sufficient altitude the bomb can be launched at a good distance from the objective

In aeronautics it is never safe to discourage any device, but there are in this invention quite a number of difficulties to consider



Pacific & Atlantic

Artist's sketch showing manner in which small pilot plane is fixed to a twin-engined airplane with a long range of flight

Science Notes

Setting the Clock in Camp

Few campers have escaped the annoyance of finding that they have forgotten to wind the only watch in camp, and that they are therefore without knowledge of the time

Sunrise and sunset move, in the latitude of New York, over a range of some three hours; and on a given day the sun itself, in its apparent motion across the sky, travels fast near the horizon and slowly near the meridian. There is, however, one feature of sun time which is fixed; the sun is at its highest at noon This makes it easy to determine the time quite accurately.

Erect a pole of any height and measure the length of the shadow which it casts as early in the morning as is convenient With the pole as a center, swing a circle, using this distance as radius. In the afternoon, after having contracted to its minimum and again lengthened out, the end of the shadow will again reach this circle Then the shadow at true noon lay half-way between the two points thus marked. If the watch were started at the time of the morning observation, the correct time at the moment of the evening observation is obtained by dividing in half its record of the elapsed time

Thus, suppose an early reading were taken, a shadow length of thirty feet seven inches noted, and the watch set going from the eight o'clock mark. The afternoon shadow, let us say, reaches the same length as 4.42 by the watch The elapsed time is eight hours, forty-two minutes. Half of this was before noon, the other half after. The correct time at the moment of the evening reading is then 4:21

The longer the period of the day over which the test runs, the greater the accuracy

How Long Is a Seed's Life?

Beet seeds retain their germinating power for 17 years, according to experiments recently conducted by Professor K Dorph-Petersen, of the Danish Seed Testing Station A considerable number of these seeds were stored away seventeen years ago and some were withdrawn every year for experiments. The tests showed 85 percent of germination the second year and twenty-four per cent the seventeenth year of dormancy Seeds of white clover germinated after twenty five years Only a few grass species tested showed much life after seven or eight years It would also seem that environmental conditions may influence the length of time a seed may remain alive

Grafted Oranges and Lemons to Grow in Deserts

The cultivation of oranges, lemons and other citrus fruits in regions that are at present too arid for them is expected to result from the accidental discovery at the U S. Experimental Station at Indio, California, of the proper method of grafting flowers and fruit on the Australian desert lime tree

This is the only plant that is closely enough related to citrus fruits to permit grafting, and that will also grow under desert conditions in alkaline soil, and in greater cold than other citrus species will stand. Therefore, as a stock on which citrus fruits may be grafted, it has long been expected to extend the range of orange and lemon culture into regions hitherto unsuitable for these fruits.

The only difficulty thus far met with has been that this species would not produce seed, no matter how generously irrigated. No seed, no grafting stock! A specimen that stood near an irrigated terrace, and received a constant small trickle of water surprised workers at the station by breaking into bloom; whereas other trees that had had their roots copiously flooded once a month refused to put forth a bud. This hint was therefore that the trees really needed a constant though small supply of water, instead of intermittent floods An abundance of young seedlings are now available for propagation purposes.

The White Pine Situation in 1926

There is no longer any reason why the man who must have Genuine White Pine cannot get it

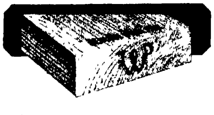
YOU hear less today than you used to about the scarcity of White Pine. The reason is that in almost every community there is a growing number of lumber users—foundrymen, patternmakers, skilled carpenters and fine artisans of one kind or another—who cannot be satisfied with any other wood than White Pine.

These men know White Pine for its remarkable durability under exposure to the weather—for its fine even texture—its ease of working—its ability, once in place, to hold true without warping or twisting or opening at the joints.

They have used other woods and they know the difference.

And because they have continued to demand it you will find in almost every community today at least one of the local lumberyards carrying a stock of Genuine White Pine and building a reputation for personal service and fine quality lumber that helps them to sell many a bill of ordinary dimension and boards.

THAT makes it increasingly difficult for the man who tries to induce you to accept a substitute on the excuse that "you can't get Genuine White Pine any longer."



To disprove such a statement you have only to walk along to his competitor's yard and select just the pieces you want for the work in hand—not one of the woods sometimes sold as White Pine, but Weyerhaeuser Guaranteed Genuine White Pine, each piece species marked for your protection—made, processed and seasoned according to Weyerhaeuser standards of manufacture.

IF your local dealer does not have the particular grade of White Pine you want, have him get in touch with the nearest Weyerhaeuser representative or write us.

Weyerhaeuser Mills are manufacturing year in and year out hundreds of millions of feet of Genuine White Pine available to dealers in carload shipments from any one of eight different mill stocks, or mixed car shipments on 24-hour notice from a large centrally located distributing plant.

It is remarkable how easy it is to get White Pine when you find the dealer who is merchant enough to recognize that the biggest sales leader he can have is a regular following of local buyers, who know from experience that even at a higher price per thousand feet, Genuine White Pine in terms of the job in hand is more economical in the long run

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Weyerhaeuser Forest Products are distributed through the established trade channels by the Weyerhaeuser Sales Company, Spokane Washington, with branch offices at 208 So. La Salle St, Chicago; 220 Broadway, New York; Lexington Bldg, Baltimore, and 806 Plymouth Bldg, Minneapolis and with representatives throughout the country

"Your radio is always top notch. What do you do to keep it so full of pep?"

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The rule which determines the right size "B" batteries to use is so simple no one can make a mistake, and once learned it definitely settles the question of "B" battery service and economy.

On 1 to 3 tubes—Use Eveready No 772.

On 4 or more tubes—Use the Heavy Duty "B" Batteries, either No. 770, or the even longer-lived Eveready Layerbilt No. 486.

On all but single tube sets—Use a "C" battery.

When following these rules, No. 772, on 1 to 3 tube sets, will last for a year or more, and Heavy Duties on sets of 4 or more tubes, for 8 months or longer.

These life figures are based on the established fact that the average year-round use of a set is 2 hours a day.

A pair of Eveready No. 772's for a 5-tube set instead of 2 Eveready No. 770's or 2 Eveready Layerbilts No. 486—looks at first glance like an economy because of lower first cost. But in a few months the 772's will be exhausted and have to be replaced. After the same length of time the Eveready No. 770's or the Eveready Layerbilts No. 486 will still be good for many more months of service.

We have prepared for your individual use a new booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send on request. This booklet also tells about the proper battery equipment for the new power tubes.

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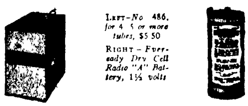
WCAE—*Pittsburgh*
WSAI—*Cincinnati*
WEAR—*Cleveland*
WWJ—*Detroit*
WGN—*Chicago*
WOC—*Davenport*
WCCO { *Minne* / *St Paul*
KSD—*St Louis*

Pacific Coast, Eveready Program
KGO—*San Francisco*, 8 to 9 P M.

*NOTE In addition to the increased life which an Eveready "C" Battery gives to your "B" batteries, it will add a quality of reception unobtainable without it



LEFT—*No* 486, *for 4, 5 or more tubes*, $5 50

RIGHT—*Eveready Dry Cell Radio "A" Battery*, 1½ *volts*

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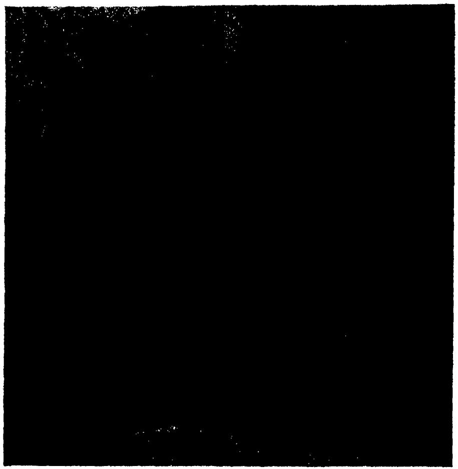
Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



International Newsreel

The vacuum-tube power unit of England's most powerful station. The big British station is at Hillmorton, near Rugby, England

Rugby's Range Is World-wide

THE new British station at Rugby, England, with its total power output of 1,500 kilowatts, is being heard in all sections of the world according to reports reaching the station.

Two-thirds of the power is used for wireless telegraph communication and one third is reserved for long-distance radiophone experiments. The code messages will be broadcast on long and short waves. The radio telephone plant is designed to cover 5,000 miles Twelve masts, each 820 feet high, hold the aerial wires aloft It is expected that the long and short-wave equipment at Rugby will insure satisfactory transmission to every part of the Empire throughout the twenty-four hours.

Foresees Broadcasting of Heat

BROADCASTING of heat by radio is predicted by Professor S. E Dibble, of the Carnegie Institute of Technology and President of the American Society of Heating and Ventilating Engineers. He contends that it is no more improbable to broadcast heat waves than it is to broadcast sound wages. But, before this can be done, he points out, research workers must discover instruments to control heat waves, chiefly a detector which will intercept the waves, hold and amplify them.

"Transmission of heat by atmospheric conductivity is essential because of the gradual exhaustion of the elements of fuel," said Professor Dibble. "The day is not far off, in my opinion, when we shall see huge centralized heating plants broadcasting heat to homes, industries and office buildings Our hope is to incline the activity of research men toward this objective. We know that heat travels through space, through solids, and when we once learn how to pick up these waves and control them, heating throughout the world will be revolutionized. Heat broadcasting will mean better health to the public, because it will eliminate from the air the impurities of present-day heat-making systems"

Radio Centre for New York

A RADIO Centre has been established as a permanent exhibition and market for radio products by the Bush Terminal Company, of New York Two floors in the Bush Terminal Sales Building and more than 20,000 square feet of space has been leased to the Radio Centre, Incorporated. Colonel S. H. Mapes is President of the new company.

The Radio Centre is intended to be a sort of bourse for radio manufacturers and a service market for buyers Instead of traveling from one end of the city to the other to make comparisons, the buyers can see the products of many manufacturers under one roof. Sound-proof booths have been installed so that each exhibitor can have absolute privacy and the radio parts can be exhibited under actual working conditions.

Madrid Broadcasts at Late Hour

MADRID, Spain, stays on the air later than most of the other European broadcasters, and may be heard between 7 and 8 P.M., Eastern Standard Time, on the 392-meter wavelength. Dance music is generally the feature on the late Spanish program.

KMOX Pays Talent

KMOX, "The Voice of St. Louis," pays its program artists according to reports from the studio. The payroll for entertainers and station staff totals approximately $3,000 a week.

Yucatan Blamed for Static

THE crashing and grinding static noise which disturbs radio listeners in the United States originates in the atmosphere of Yucatan and Mexico, according to Dr. L. W.

Radio compass of the S.S. *Alaunia*. Instead of using a revolving loop antenna as its direction-finder, this ship has a fixed frame or "box aerial," which is attached to this receiver for determining the ship's position

Austin, of the Bureau of Standards. It is believed that "upside-down" lightning, which consists of a steady discharge of electrical energy from clouds into a conducting layer high above the earth of Central America, is the chief source of static.

Observations show that there are three types of static disturbances, all of which originate from different causes. The frying or grinder noise is known as grinder static; and it is the most troublesome. Sharp clicks caused by a lightning storm form the second type of static, and a hissing sound, caused by heavy snowstorms, is rated third

When Marconi made a trip across the Atlantic in his yacht *Electra* in 1922, he made extensive observations of static He reported that up to about half-way across the sea, the disturbances appeared to be coming from the vicinity of the African coast At more than half-way across, the strays apparently originated over the American continent.

Tests made by radio engineers reveal that up to very high wavelengths, the increase in static's intensity is proportional to the wave length. It has been estimated that static is about 20 times as strong on 17,000 meters as at 3,000 meters, and that above 25,000 meters there is a decrease in the static intensity.

Observations made at stations along the Atlantic seaboard indicate that strong static in the afternoon and night is produced in the southwest Static picked up in the morning and in the winter seems to be evenly distributed in regard to source

Static noise is usually at a minimum about 1:30 A.M., and just after dawn, when there is a deathlike silence in the ether. Its maximum volume is reached from 10 P.M. to midnight. If static is noisy from about 6 A.M to 10 A.M., it can generally be taken as a warning of an approaching electric storm or a decided change in weather.

Up to the present, there is no device or system to entirely eliminate static The strength of an incoming radio impulse at the receiving set is estimated to be one-millionth of an ampere Thus, it can be readily understood that a heavy charge of lightning, more powerful than all the broadcasting stations put together, has a great influence in the ether and should have little difficulty in sending a click around the world

Germany Extending Radio on Trains

RADIO telephony on board German trains between Berlin and Hamburg has been so successful that other trains are to be equipped, according to Ernest Schmitz, a representative of the German railroads, who recently visited the United States.

"Despite the noise inseparable from a train," said Mr Schmitz, "and despite the constantly changing distance over which a

Telephone and radio, supplementing each other, bring passengers on the trains running between Berlin and Hamburg within communication range of home. The train's operator establishes the contact between passenger and telephone exchange

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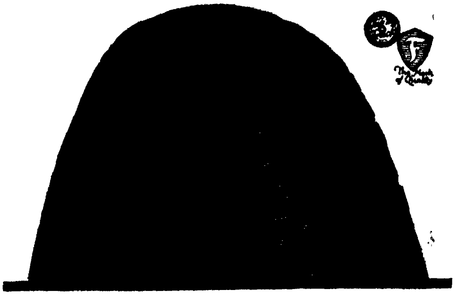

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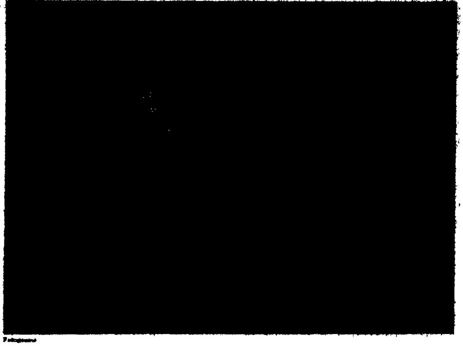


Recording the size of short radio waves on his wave meter. Mr. W. W. Salisbury, at the State University of Iowa, has produced Hertzian waves 1.3 meters in length. His new wave meter, shown in this photograph, is used in experimenting with very low wavelengths

three-minute radiophone conversation is carried on, the trains cover some three miles during the talk and the audibility leaves nothing to be desired. The connection is made as speedily as in the case of the ordinary long-distance call"

To receive a call on an express train is just as simple and easy as to be called to the phone by a page boy in a hotel lobby, according to Mr. Schmitz. A messenger boy with the lettering, "Train Telephony, Ltd." on his cap passes through the trains and announces the telephone calls received at the trains radio station. The person paged follows the boy to the radio compartment of the coach, where a telephone operator presides over the switchboard. Near her is an ordinary telephone booth and the person called enters the booth and is connected with the person making the call in Berlin or Hamburg.

The train passengers can likewise make calls. The charges are slightly higher than those of a long-distance telephone conversation.

The station on the train is a combination of telephone and radio. There are three transmitting stations on the Berlin-Hamburg line, one at both cities and one mid-way. The aerials of the train station are located on the roof of the cars.

San Francisco's Antenna Rules

REGULATIONS governing the installation of radio antennas have been issued by the Department of Electricity of San Francisco. No antenna shall be erected over any street or any wire carrying more than 600 volts, or be fastened to any pole supporting light or power lines.

There shall be a vertical clearance of at least eight feet over any flat roof and four feet over any peaked roof. All wires used to support the antenna shall be either copper or galvanized and not smaller than number 14 gage. No antenna or supports for the same shall be attached to a fire escape.

Lead-in wires shall not be smaller than number 14 gage and must be substantially supported, to prevent the wires coming in contact with any light or power wires. The ground wire may be bare or insulated, but it may not be smaller than number 14 gage and must be securely fastened to the pipe.

Radio Service for Farmers

A RADIO service department has been organized by the Department of Agriculture to supply agricultural program material to broadcasting stations. Samuel Pickard is in charge of the new bureau.

Much of the material furnished to the stations will be prepared for presentation in a radically different manner from the universal practice of reading manuscripts. The broadcasting stations will be asked to provide personalities who have unmistakable qualifications to voice the information, which in most cases will be presented in popular style and in the form of dialogue or questions and answers.

"Fifty Farm Flashes" will be offered as a regular feature. The "flashes" will consist of interesting current information sought by farmers through the several thousand letters received each week by the department in Washington.

Other special feature programs are under consideration, among which are the "Housekeeper's Half-hour" and the "National Farm School." In the latter, the farm will be considered as the student's laboratory. Timely lecture courses which dove-tail with the daily farm work will be developed, and laboratory assignments will be made which necessitate putting into practice the subject matter taught over the air.

Short-wave Station Makes New Record

STATION 2GY, an amateur short-wave station at Garden City, New York, established a new record for low-power transmission by carrying on two-way communication with station 9CCQ, Braymer, Missouri, using only .04 watts power in the plate circuit of the transmitting tube. Both stations employed standard receiving tubes and "B" batteries as their power source. The transmission feat of 2GY represents 25,525 miles per watt.

Assuming a cost of ten cents a kilowatt hour, the highest prevailing rate charged by power companies, this transmitter's plate current can be supplied for eighty-five years, eight hours a day, at a total cost of one hundred dollars.

If radio messages could be radiated as efficiently throughout the universe, the largest 100-kilowatt installations could be heard over a distance of 2,552,000,000 miles, sufficient to reach the distant stars of the solar system; and Mars would be within easy range of the larger broadcasting stations.

At an average rate of transmission of 20 words a minute, the power to send a message of 40,000,000 words would cost only one dollar, if purchased at ten cents per kilowatt hour; while this same transmission over telegraph lines at the rate of a night letter would cost $576,000.

"Broadcasting" Wins

At a meeting of the National Association of Broadcasters the question was raised relative to substituting the word "radiocasting" for "broadcasting." It was unanimously decided to use "broadcasting."

Kadel & Herbert

Radio set with thirty-two loudspeakers. This method of comparing the quality of reproducers is used by J. D. R. Freed. By means of a switching device, any loudspeaker can be put into use and an electric light in front of each speaker is illuminated to show which instrument is in operation

Station OKP

A 5-KILOWATT Western Electric broadcast transmitter is now in operation at Prague, Czecho-Slovakia, and can be heard on the 368-meter wavelength. The broadcasting hours are: 5 to 6 A.M., 10 to 11 A.M., and 3 to 4 P.M., Eastern Standard Time. The call is OKP.

Minimizing Code Interference

THE Navy Department has called attention to shore radio stations regarding the prescribed silent periods. Naval transmitters of a type likely to cause interference to broadcast reception are supposed to remain silent between 7 and 11 P.M., Eastern Standard Time, except in cases of emergency. Ships are requested to co-operate by refraining from calling the shore stations during this desired silent period.

Station GBR

ENGLAND'S powerful transmitter at Rugby is known in the ether as "GBR," and it can be heard on the 18,000-meter wavelength. It registers in America and other parts of the world with strong signal strength.

Egypt Hears WGY

THE 41-meter wavelength of WGY is bringing in reports of reception from all quarters of the globe. C. W. Biddulph, of Alexandria, Egypt, reported: "Very clear phone strength. Every word clear as a bell. Your program concluded at 7:30 A.M., our time, and as the announcer closed down WGY's short-wave transmitter the sun was rising rapidly up over the desert."

Unique Aerials Used at KDKA

STATION KDKA is using two distinct antenna systems, one an upright copper tube and the other a flat top horizontal structure. The former is for short-wave broadcasts and the latter for the 309-meter programs, which the majority of broadcast listeners within the range of Pittsburgh hear.

The station's engineers claim that it has been practical to build the upright antenna so that its natural wavelength is close to the wavelength radiated from the aerial. This means that very little tuning of the aerial is required and the losses of power through tuning are minimized.

The fundamental wave of the horizontal antenna is not quite so close to that of the radiated wave.

Wooden poles, dried and treated with a water-proof preparation, hold the aerials aloft and insulate them from the earth. This is a departure from the use of steel structures. The wavelength used in the short wave experiments is around 60 and 65 meters, and the short-wave aerial is approximately half a wave in length. Several aerials are used in the low-wave transmitting system. These aerials are located with the idea of obtaining directional effects for long-distance relaying. Each aerial consists of a copper tube supported vertically on a wooden pole, with a small horizontal counterpoise element at the lower end, and about four feet from the ground. Long porcelain insulators hold the tube rigid.

The length of the short wave radiated by the transmitter expressed in feet is approximately 200 feet. The aerial is a few meters less than half the length of the wave which it radiates; but the short horizontal counterpoise at the bottom of the tube and the lead-in connection with the apparatus help to compensate for the deficiency in length and bring the natural wavelength of the aerial near that which is broadcast.

In order to make necessary tuning adjustments of the aerial circuit, the copper tube is cut in half near the middle, and a ground coil is placed in the space between the two sections of the tube. Slight adjustments of this coil make it possible to tune the aerial circuit so that its natural wavelength is exactly that which is transmitted.

Only one of the several short-wave aerials is coupled to the broadcasting equipment. The others are located at certain predetermined distances from the main aerial and are energized by induction. Their purpose is to give the directional effects. When two of the aerials are separated by exactly half a wavelength, the signals have maximum strength at right angles to a line drawn between the two aerials. If two aerials are separated by a quarter of a wavelength, the condition is reversed.

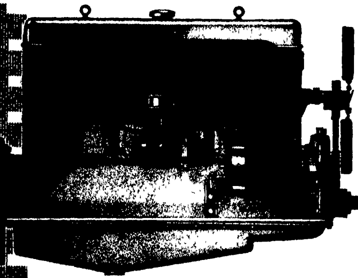
An upright aerial is not used for 309-meter broadcasts because it would require a mast nearly 500 feet high

Community Programs Beneficial

CINCINNATI reports that community programs radiated from station WSAI have unexpected and unsolicited commercial value. The Cincinnati manufacturers and wholesalers sent out monthly invitations to their mailing lists, and a substantial increase in business was noticed.

Ireland Goes on the Air

THE first broadcasting station in the Irish Free State has been built by the Marconi Wireless Telegraph Company in the McKee Barracks on the outskirts of Dublin. The wavelength is 390 meters and the call 2RN. The transmitter is rated at 6 kilowatts and is similar to most of those used by the British Broadcasting Company.



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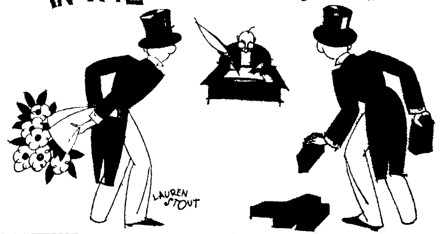


A Lasting Impression

An interesting item which came to us in our mail tells how impressions made by leaves which fell, quite by accident, on a city street nine years ago are being studied to determine the wearing qualities of concrete.

Authorities on concrete have been paying particular attention to the "leaf section" of Myrtle Boulevard, Sioux City, Iowa, where falling leaves left their impressions in the pavement nine years ago just as the concrete was being laid.

It is believed this accidental marking of the street surface may provide a valuable index of the rate of wear of concrete pavements under city traffic, a matter about which very little is known even among cement and concrete experts. The accompanying picture shows one of the imprints

Some of the impressions are in the wheel tracks where 1/32 of an inch of wear would have obliterated them. Nevertheless, during nine years of their existence none has shown any wear from the traffic, despite the fact that from 500 to 700 vehicles traverse the boulevard daily, many of them steel-tired farm wagons.

Much speculation has developed as to how many years longer the leaf impressions will last in the pavement. The one shown herewith happens to lie near the edge of a curve in the boulevard, where wear is heaviest Since nine years of rolling traffic have had practically no effect on the delicate tracery of veins in the imprint, engineers have predicted that a much longer time must elapse before the impression of the leaf is actually worn out.

H. S. McCauley.

How Many Others Have Done This?

It is with all due modesty and something akin to pride that we publish the following words of commendation from C. N. Wheeler:

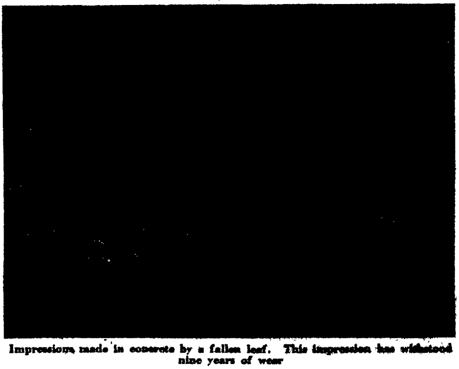
Scientific American,
Gentlemen:

Although I was not born until 1879, I have read every number of the Scientific American (and of the Supplement) since 1876, paradoxical as it may seem.

My father was a contractor and engineer and when, in 1876, the Supplement was started he subscribed for it and after reading preserved the periodical. I do not know whether he had previously subscribed to the Scientific American or not, but, beginning with 1876, he preserved all the numbers of both the Scientific American, and of the Supplement, keeping them in large boxes in the attic.

When I came of an age to read with some ease I used to go up in the attic and spend hours poring over these old papers To me they possessed a fascination beyond any childhood books. I would often ask my father about articles I had read in them, and he would explain points I did not understand. In his work he often referred to back numbers of both papers so that he gave me the task of filing and keeping filed both magazines. Finally, I became so the master of the contents of these volumes that whenever he had need of reference to an article or a subject he would tell me what it was and I would go and dig up the required numbers. My father often said that I brought him articles on the subject, or allied subjects, which he had forgotten or did not know had been published in the papers As long as I remained at home I kept up this practice. I feel that the Scientific American, and the Supplement, have been great factors in my education.

Although I am not an engineer, or a contractor, I still enjoy the Scientific American and find it very useful in my present calling, that of owner of a private school preparing men and women—



Impressions made in concrete by a fallen leaf. This impression has withstood nine years of wear

Going to Travel?

Then by all means refer to the travel section of Harpers Magazine—Every month you will find many alluring suggestions and the announcements of a large number of Tourists Agencies, Railroads, Steamship Lines, Resorts and Hotels.

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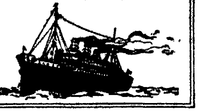

He's Patented Four Inventions

AND he's only one of scores of inventors who got their first real start through spare-time study with the International Correspondence Schools

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So is John C. Wahl, inventor of the Wahl Adding Machine and the Eversharp Pencil, W. E Hallett, inventor of the Hallett Tandem Gas Engine, H E Doerr, Chief Mechanical Engineer, Scullin Steel Company, and W. J. Libby, inventor of the Libby Mine Hoist Controller.

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World's first rotor ice boat on Androscoggin Lake in Maine. This boat was designed and built by Carlisle A. Lincoln who describes it on this page

from sixteen to sixty—for colleges and technical schools. In eleven years not one of the pupils I have sent to college has failed in his work there, and I have sent pupils to such exacting schools as Massachusetts Institute of Technology, Harvard, Yale, University of Pennsylvania, Worcester Polytechnic School, West Point, and others. I think my success has been due in no small measure to the habit of thoroughness and accuracy instilled into me by my father and the Scientific American, and Supplement.

During a short stay in New York a goodly number of years ago I got to talking with one of the caretakers of the Brooklyn Bridge. He was much surprised at the knowledge I showed of the construction of the bridge and asked me if I were an engineer engaged in steel work. All my knowledge of the structure had been gained in my youth by reading the articles in the old numbers of the Scientific American and in other works on bridges, the Scientific American articles having stirred my curiosity to pursue the subject still further.

I could quote many other instances where the articles in your paper have been the entering wedge to further research.

At present, when the Scientific American arrives, it is a rush to see whether my son or I get it first.

Very truly yours,
C N Wheeler.

A Rotor Ice Boat

Mr. Carlisle A Lincoln of Wayne, Maine, has sent us pictures of a new rotor pleasure and ice boat which he has constructed. Excerpts from Mr. Lincoln's letter follows:

The size of the "rotor motor" and a few of the details, may prove interesting The rotor body is three feet in diameter and is eight feet high, with flanges top and bottom each six feet in diameter, the flanges being twice the diameter of the rotor. The top and bottom flanges with the intermediate fin are made up of wallboard, held in place, attached and reinforced by spruce cleats. The outer surface of the rotor is also built up of wallboard sections. Pipe of different sizes serves to support the rotor and one of the pieces of pipe emerges and forms a flag staff. The cylinder revolves on a floating oil sliding bearing at the base, and a floating oil bearing at the top of the apparatus.

To spin the rotor, a round belt from a pulley on the rotor passes to a much smaller pulley on the top of the flywheel of a two-horsepower, two-cylinder, outboard motor. The motor being a one-way engine, a straight and a crossed belt are used so that either belt can be used to revolve the rotor in opposite directions for the different tacks.

The outboard motor is attached on the ice boat by an upright plank well braced to the main frame. The propeller of the motor is taken off and the shaft put into a five-gallon oil can with a section of the top intact. When the can is filled with water it acts as a part of the cooling system. The motor can be swung back or forward at will to allow the belts to slip so that the motor can start first with a loose belt and then tightened to spin the rotor. When the rotor is humming like a top, the motor and belt is set to position and this speed can be controlled entirely from the motor. This ice boat gathers speed rapidly as there is nothing to hold it back in its frictional contact on the surface of the ice. The ice boat is of conventional design.

The same rotor outfit was previously used on a pleasure sail-boat craft, except that in its installation the mast was shorter to allow the rotor to be as close to the deck of the boat as to bring the center of gravity as low as possible.

Determination

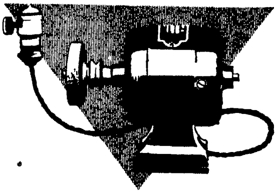
Here is an interesting letter from a Marine who wanted to make a telescope, two or three years ago, but could find neither the proper directions nor the materials. Owing to his inability to get the finer grades of abrasives, he was forced to do his fine grinding, in addition to polishing, with rouge, an abrasive that cuts, quantitively, extremely slowly. It took him 200 hours! He stuck—he was a Marine

Sir.

I have my instrument practically finished, it being the result of some idle star-gazing in some of the South Sea Islands two or three years ago. The following chronicled interest in telescopes dates, therefore, from my first sight of the Southern Cross

Grinding on the mirror started with what little knowledge was retained from an article published some ten years ago in "The Experimenter," or some magazine of similar nature The process of pitch polishing with trimmed-down squares near the edge of the polishing blank was retained, but the Foucault test was so hazy that recourse

The rotor principle applied to a pleasure craft. As will be seen, the mast is shorter than that used on the ice boat



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A reader who is grateful for the blessings of modern surgery sends us this X-ray picture showing how a surgeon made a dowel pin of a piece of shinbone, to repair his broken arm

was had to Herschel's scheme of sighting on a star as he ground out his figure. My method was perhaps pretty crude to start with, the moon being tried and the spherical blur removed; then Venus with removal of the blur, and then a star

The greatest initial trouble was finding anything published concerning either lenses or mirrors, having searched some two or three dozen libraries between here and China. The few articles in the Library of Congress were of no immediate help.

It may interest some makers and perhaps excite the pity of others to know that I rough ground my glass with valve grinding compound and then immediately started in with the rouge; and that the rough grinding took only four hours, but the polishing took over two hundred hours. Bringing the figure from a sphere to a parabola took about eight In explanation of the above, I found it impossible to get even flour of emery in Washington or nearby places, and no rouge, either (except from beauty shops). The rouge was finally begged from a mirror works.

With the abundant help consisting of information concerning sources of supply, the constructor should know something of his *possible* troubles in order to appreciate your help.

After reading the excellently clear exposition of the Foucault shadows by Mr. Porter in the February Scientific American, I tried my supposedly finished mirror by means of them, and found that my glass was somewhere between a hyperbola and a parabola. The fact that I used only a low-power eyepiece may account for my impression of having had a good mirror. About thirty minutes polishing brought the shadows on my glass to a counterpart of the short focus parabola shown in the illustrations at the top of your pages.

Sincerely,
Virl Davenport.

Marine Flying Field,
Quantico, Virginia.

Ingenuity of the Surgeon

Sometimes the modern surgeon patches us up just as one would patch up a torn suit of clothes—by taking out a piece where it is not needed and putting it where it is.

A reader in Tonopah, Nevada, sends us the following letter:

Editor,
Scientific American:

The writer was injured in a railroad wreck and was taken to Los Angeles to have a broken arm set. It was a double, compound fracture which occurred when a coach on the Tonopah and Tidewater Railroad, which was built to bring "Twenty Mule Team Borax" out of Death Valley, was derailed at the upper end of that depression. Seventeen days elapsed before I got out of Death Valley so that I might have an operation on my arm.

In December, 1922, a Los Angeles physician drilled the broken bones and laced them together with kangaroo tendons. The radius bone made a perfect knit, but the ulna wasted away. A year later, therefore, the same physician removed a piece of the shin bone and inserted it into the narrow canal of the ulna, thus making a dowel-pin. No screws or metal pins, no lacing and no plates were used. My age was then forty-eight, but I never was forced to walk with a cane or a crutch.

I now use both hands, can climb ladders and do almost anything. The arm is just a little stiff but this is due to the long period during which it was in a cast. The operation is considered a wonderful piece of work.

I have another rather interesting photograph that might also interest you. The shrikes are a large family of birds, known as the "butcher birds" from the fact that they impale mice, small birds, lizards and rodents upon thorns while still living, and probably return to them later for food.

Out on the Great American Desert, miles from water and trees, I was rather surprised to find a pair of loggerhead shrikes. They must have been migratory for I had never seen any before, nor since in such a locality.

Butcher birds impale their victims on thorns for safe-keeping. Here there was no thorn. A broken wire served instead

This photograph of a lizard, shows the way the lizard has been impaled upon a splice of a guy wire of a power line. This was so unusual that I caused the pole to be otherwise guyed, cut this piece of wire out and carried it to town to have it photographed.

While the habitat of the shrikes is varied, and the geographical distribution of their families is large, the desert environment is not expected to encourage their existence here.

Lemon Ballat.

Notes and Queries

Conducted by Albert A. Hopkins

This department is intended for queries of general interest. Only a small percentage of the queries we receive can be printed here, the great majority being answered by mail. Except in special cases we cannot solve mathematical problems, give directions for building machinery or answer queries of a special nature which belong within the sphere of the professional engineer. All queries must give the name and address of the inquirer and must be accompanied by return postage. In writing about book orders or subscriptions please use separate sheets, give your name and address on each.

The Keeley Motor

Dr. M. W. McD. asks: *"Can you give me any references to the Keeley fraud which were published in the Scientific American?"*

Answer: We are afraid that you will have trouble in getting the papers as most of them have been out of print for years. As you live in New York you can see them at the New York Public Library. Here is the list:

Number	26,	Volume	32
"	2,	"	22
"	3,	"	33
"	15,	"	51
"	5,	"	80
"	4,	"	80
"	28,	"	79
"	21,	"	108, page 473

In Volume 80 our own investigations at the Philadelphia Laboratory are described.

Weight of Rain and the Wettest Place

E. A. A. asks: *"How much would an inch of rain weigh to the acre of ground and where is the heaviest rainfall in the world?"*

Answer: These are both interesting questions. The weight of an inch of rain on an acre of ground would be 226,512 pounds. The wettest place on earth is Cherrapunji, India, where there is an annual precipitation of 457.80 inches.

Quenching of Copper and Brass

J. M. R. asks: *"How can I quench copper and brass?"*

Answer: Quenching copper, brass or bronze from a red heat will have no particular effect on the metal. In the case of red brass or yellow brass such quenching would require to be carefully carried out, otherwise the objects would break into pieces or crumble.

In foundries, brass castings of the different alloys in use are cooled by water right along; sometimes to "blow out" the cores and clean the castings, and occasionally to hasten their cooling for some impatient customer, or they may be chilled by water while in the mold to prevent local segregation which would cause the castings to leak under pressure, but such treatment produces no hardening effect, if anything they are softened thereby in small degree. Heat treatment is sometimes applied to certain alloys in cast form—the bronzes—but this is done to change the crystal formation to one more desirable, than to effect the hardness of the metal. The nonferrous alloys are not affected like the steels by rapidly cooling them.

Sulphur As a Fertilizer

A. E. H. asks: *"Can you give me information as to sulphur as a fertilizer?"*

Answer: We referred this matter to the Department of Agriculture and this is their reply:

"While the Department has not issued a publication on the subject we take pleasure in supplying you with information as follows: While it is unquestionably true that sulphur is essential to plant growth, especially in connection with the formation of certain essential oils, and for the proteins, which are present in all vegetation, yet the direct use of sulphur for different crops in the eastern part of the United States, particularly when fertilizers containing acid phosphate, kainit, manure or double salts, sulphate of ammonia or any other sulphur-carrying material is used, remains to be proved necessary. It is also true that, in general, the soils of the eastern United States appear to be fairly well supplied with sulphur in some form. In certain sections of the far west there are soils which seem to be strikingly deficient in sulphur and which respond to applications of either elemental or combined sulphur. These findings are based on experimental work conducted chiefly by the Oregon and Washington Agricultural Experiment Stations, respectively. Publications which have been issued by these stations may be obtained from them direct.

"In summing up the sulphur situation as it applies to soil fertility problems, we find that the use of commercial fertilizer or barnyard manure, which carry sulphur, tend to adequately supply the sulphur requirements of plants. Another source of supply comes from the rainfall, certain investigators estimating the annual addition of sulphur to be from six to eight pounds. This will vary in accordance with the location, whether in the country or near cities. On the other hand, the Rothamsted (England) Station estimates losses by leaching, based upon the yearly drainage from the experimental fields, to be about twenty pounds. Under such conditions, unless some material is applied to the soil which furnishes sulphur, the possible need of an artificial supply of sulphur will have to be given some consideration in connection with soil fertility research. This has been recognized in the far west, as has been pointed out, where investigations show the need of applying some sulphur-carrying material in order to obtain satisfactory crop yields.

"A more general soil fertility survey involving field tests may broaden the extent of soil areas to which sulphur may be profitably applied, but such studies have not yet been deemed necessary from the present state of our knowledge on the subject of sulphur as a fertilizer.

"Sulphur is being used to determine whether it is practicable to control potato scab by applying it to soils which are infested with the potato scab organism. Results of some promise have been obtained along this line. In such trials the principle involved has been one of making the soil more acid, at least to the point at which the scab organism fails to function actively.

"It might be desirable to suggest to your correspondent that he write to some of our State Agricultural Experiment Stations for their available publications on the subject in which he is interested

The list of stations which follows may be helpful:

"Wisconsin Agricultural Experiment Station, Madison, Wisconsin;
"Illinois Agricultural Experiment Station, Urbana, Illinois;
"Kentucky Agricultural Experiment Station, Lexington, Kentucky;
"Ohio Agricultural Experiment Station, Wooster, Ohio;
"Kansas Agricultural Experiment Station, Manhattan, Kansas;
"Oregon Agricultural Experiment Station, Corvallis, Oregon;
"Washington Agricultural Experiment Station, Pullman, Washington."

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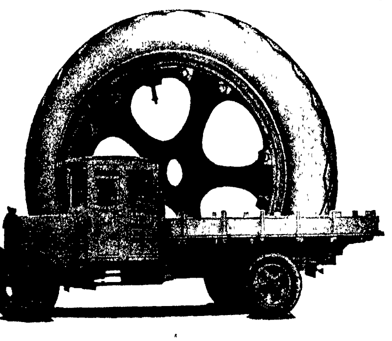

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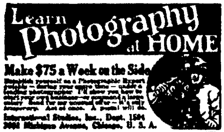

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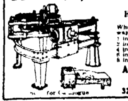

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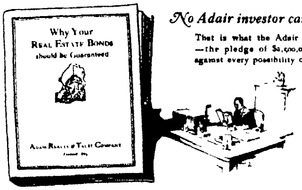

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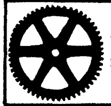

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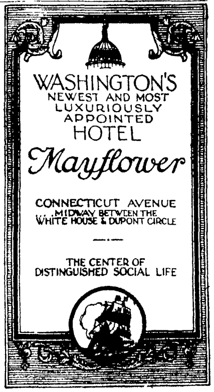

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49 East 33rd Street, New York, N. Y.

Science and Money

Some Aspects of Rubber

By Henry C. Trundle

ALTHOUGH it is popularly believed that tire production is responsible for rubber company profits, there were many knowing shareholders of several such companies who, in January and February, were wishing for severe storms and slush so that their companies could dispose of the accumulated supplies of rubbers, boots and other footwear, because the sale or non-sale of these products would to a large extent determine the size of 1926 dividend payments. Naturally, however, with some 5,000,000 automobiles being turned out a year, practically all equipped with five tires, and with normal replacements of tires for all the millions of cars manufactured during the past 20 years which are still in use, this angle of the business is not to be minimized.

In fact, 62,000,000 tires were said to have been manufactured in 1925 in contrast to but 18,000,000 in 1916. These figures alone are an index to the enormous increase in the consumption of rubber and make it evident that problems of production and merchandising should arise. Henry Ford maintains that there will be eventually 30,000,000 automobiles in the United States. Unless some substitute for rubber tires is found, supply has its own little job of keeping up with demand all laid out for it.

The change in fashion from cord tires to balloon tires, together with the increased demand for tires, has been largely responsible for the shortage in rubber about which so much has been heard in recent months. The balloon tire utilizes a third to a half more rubber than the older cord tire, and as practically all the 1925 and 1926-model cars were equipped with them, the consumption of rubber has for that reason jumped far beyond former estimates of probable present requirements.

The British Monopoly

But what has been particularly responsible for the increase of its price is the fact that rubber is practically a British monopoly. We grow very little, if any, of our own, but purchase most of it from England and its colonies, who apparently have us at their mercy through a simple legislative act—the Stevenson Plan, which has considerably disturbed Americans.

This plan was adopted in 1922 at a time when over-production was imminent. This condition was to be avoided by restricting the exportation of rubber to "a fixed standard production assigned to each plantation." No effort was made to limit the planting of trees or to decrease production, as there was no intention to create a shortage either then or some five years afterward when new plantings would begin to bear. At the time there had been a great slump in the market price of rubber and enormous stocks of rubber had accumulated, adding to the general depression.

Producers, in accordance with the provisions of the Stevenson Plan, were allowed to export only 60 percent of their "standard production," but a scale was arranged whereby, if the price of rubber was maintained above 30 cents per pound for three consecutive months, an extra five percent in exportation should be allowed the next quarter; if the price was maintained at 36 cents, a ten percent increase was allowed. A decline from 30 to 24 similarly restricted exportation by five percent. The price was thus thought to be fixed at around 36, and indeed, it averaged about 30 cents a pound for two years thereafter. The year 1925 marked the turning point, the price rising from 36.7 cents in January, to $1.03 in July. Under the regulating plan, the export allowance was increased to 85 percent of "standard production," and later increased to 100 percent in February of this year. The Plan, under present price conditions, therefore, is non-restrictive.

Although intended to stabilize the industry, the Stevenson Plan has led to international friction and ambitious plans on the part of American rubber interests to disassociate themselves from foreign dependency. In refutation of the allegation that England, through operation of the Stevenson Plan, expects to pay off her War Debt to America, amounting to $4,000,000,000, arguments are put forth that the run-up in rubber prices was due solely to supply and demand.

What Shall America Do?

Obviously, the way for America to provide for an adequate supply is to grow it herself. Unfortunately the climate of the United States is not one suitable for rubber production, so that it is necessary to acquire plantations in Mexico, the Philippines, Dutch East Indies or West Africa. Perhaps Mr. Firestone's proposal to put some $100,000,000 into his Liberia venture is better known than any other scheme. The probabilities of his plans materializing are small, since his estimates of operating costs are generally regarded as decidedly low, and as such a sum is considerably more than the capital and surplus of his present company. Indeed, it is hardly conceivable that his stockholders would sanction such an undertaking despite its attractions.

Real relief is coming through the United States Rubber Company which has some 124,000 acres or 194 square miles of rubber plantation lands in Sumatra, representing an investment of approximately $25,000,000. In 1925 about 20,000,000 pounds of rubber were obtained from this source and this amount is expected to be increased 75 percent in six years, through new plantings and more mature bearings.

The formation of a $10,000,000, rubber-producing corporation in January by members of the National Automobile Chamber is a forward step toward the solution of the problems at hand. At the same time "The Rubber Association of America" was organized, which expects to expend $50,000,000 over a period of five years in the planting of rubber trees in areas under American control, or where favorable conditions would be assured. Details were lacking at the time of this writing, but as both companies were being organized by leading figures in the rubber industry and had the backing of Secretary Hoover, it is to be assumed that the United States in the future will have a domineering position in the rubber world.

Supply Cannot Meet Demand

The perplexing difficulty of regulating supply so as to coincide with demand is that it takes five or six years for a rubber tree to reach a bearing age. Five years ago production exceeded consumption, prices were low and there was no incentive, therefore, to go ahead with plantings. In 1920 production exceeded consumption by nearly 80,000 tons. In 1924 and 1925 these figures were reversed, consumption exceeding production by about 55,000 tons.

Some idea of the immediate outlook is given in the following estimated figures as compiled by the Rubber Association (in tons).

	Estimated Production	*World Consumption*
1926...........	606,000	575,000
1927...........	623,000	608,000
1928...........	638,000	641,000
1929...........	637,000	672,000
1930...........	641,000	705,000

Rubber is now used in the manufacture of 30,000 articles of commerce, and as new

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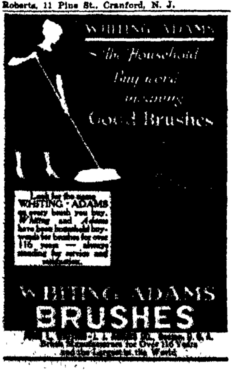

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developments in the industry are constantly taking place, it will be seen that the problem of creating a supply adequate to meet the demand of the future is a serious one.

The shortage in rubber brought forward several interesting measures to alleviate the situation. Old rubber again commanded a market, and junk men were quick to gather in all the discarded tires, hose, boots and rubber goods, which could later be offered for rubber reclamation. Scientists experimented in reclamation processes and a French engineer is thought to have made a practical discovery of importance. His method is to extract pure rubber from worn out rubber by a new catalyzing process, estimated to cost only 30 francs per ton. As British financial interests are investigating this proposition, we may expect to have its worth promptly demonstrated. An American chemist, not to be outdone, claims he has invented synthetic rubber, which can be derived from various products and even from garbage. After all, something may be developed which can be used to meet a crisis.

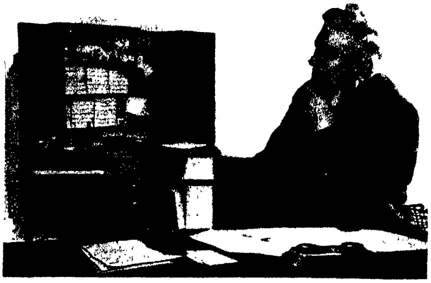
To facilitate the trading in crude rubber and rubber futures, the Rubber Exchange of New York, Inc., was organized in January, with a membership of 250, and opened for business on Tuesday, February 2nd. This Exchange operates similarly to the New York Stock, New York Cotton, the Coffee and the Sugar Exchanges. The floor is connected by telephone, telegraph and cable with the leading rubber centers of the world, and the latest information regarding conditions is available to its members. Such an Exchange is a recognition of the world importance of the commodity and its facilities will do much to protect the interests of all concerned. In view of the price of around $1.00 which prevailed for a time, it is interesting to note that the initial sale on the Exchange was for one lot, or five tons of rubber to be delivered in May at 63 cents per pound. The first day's transactions amounted to 60 tons.

Development of Rubber Companies

Unless one is actually a buyer or seller of rubber for business purposes, one will not have much opportunity to deal with the Rubber Exchange. The unit of trading there has been made purposely large to keep out the small speculator. Such persons, or others desiring to interest themselves financially in the industry will find the shares of rubber companies as traded in on the Stock Exchanges more satisfactory to deal in than in rubber futures. Rather complete information, furthermore, regarding the companies' earnings and prospects are available through newspaper and magazine articles and other published reports, so that purchases can be made intelligently. It is also possible to obtain opinions from investment houses.

The development of rubber companies has been from old establishments making iron tires for carriages, just as automobile companies have been organized from former wagon and buggy works. The history of both businesses is closely related, for each has had its periods of great depression and great prosperity. While most motor companies have paid off accumulated dividends and obligations and have established a potent earning capacity, rubber companies are just beginning to bring their financial houses in order. However, rubber concerns have come through the post-war depression period with less wounds than many other industrials. No companies have been actually forced out of business and 1925 earnings and 1926 prospects are such that great optimism reigns.

At one time it was necessary to finance rubber companies with first mortgage bonds bearing usually eight percent coupons and offered to the public at discounts. Features such as high call prices or redemption by lot were added to lend a speculative aspect and so widen the appeal. Those who had faith in the ultimate trend of the business have benefited materially, since these bonds are now quoted at relatively high prices or have been called in for payment through retirement or through refunding at much lower rates of interest. When rubber companies begin to finance improvements or extensions by the sale of common stocks,



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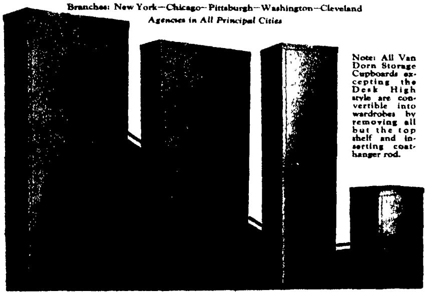

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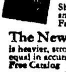

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Just forty years ago in THE FORUM, Dr. Fridtjof Nansen set forth his plans for Arctic exploration. In the April FORUM he reviews the accomplishments of the past forty years and discusses modern achievements which may be expected through the aid of modern agencies, such as the dirigible.

Dr. William MacDougal, Professor of Psychology at Harvard University urges scientific investigation of the mysterious phenomena of "ghosts," "psychics," and similar marvels.

In every issue of THE FORUM, Dr. E. E. Free, former Editor of the "Scientific American," gives an entertaining and non-technical explanation of the latest developments in the world of science.

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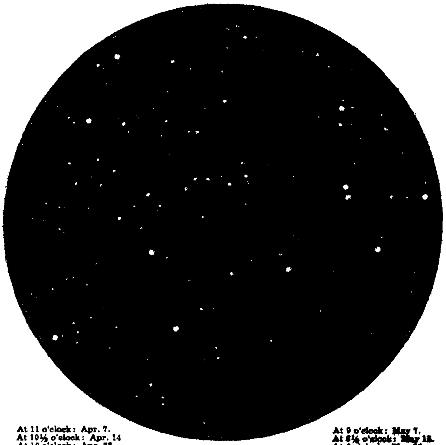
the public will know that the industry is again on a sound basis and that the bonds and preferred stocks are more nearly of investment quality.

Investors must not be fooled by the difference in price of rubber stocks and pick up apparent bargains before investigating them, for this difference is quite likely to be the amount of accumulated dividends thereon. For instance, one company has two 1st Preferred Stocks outstanding. On the same day one stock sold for 112 and the other at 86. This is perplexing until it is known that on one stock there was payable $26 of back dividends, which the holders of the other stock had already received.

The rubber industry is quite essential as a counterpart for the motor industry, aside from its great necessity in providing the various rubber articles, and an intelligent effort is being made to relieve the business of its present hazards. Undoubtedly there is much money to be made in the investment of funds in rubber stocks, both from sizeable dividends and from market appreciation of shares. Those companies which do a diversified business and which are in control of situations from the plantation to the merchandizing of the finished products, would seem to offer the greatest possibilities. Likewise, investors need not decline to invest in the bonds of rubber companies just because they are such a type of bond, for the industry is one of the ten most important ones and essential merchandise is manufactured. A return slightly higher than prevailing rates may usually be obtained from rubber company securities.

The Heavens in April

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Apr. 7.
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At 9½ o'clock: April 30.
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The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

The Heavens

IN our usual glance at the sky, we find the Great Dipper high in the north, with Draco below and then Ursa Minor and last Cepheus and Cassiopeia close to the horizon. Lyra and Cygnus are rising in the northeast, Ophiuchus in the east and Scorpio in the southeast. Above them are Hercules, Corona and Bootes. Virgo and Leo are high in the south and southwest, with Hydra and Corvus below. Auriga, Gemini and Canis Minor are well down in the western sky and Orion has just set.

The Planets

Mercury is a morning star all this month, but is best visible towards its close, when he is farthest from the sun, both apparently in degrees and actually in millions of miles. At his greatest elongation on the 28th, he is 27 degrees from the sun—his greatest actual distance, 43,000,000 miles being reached six days earlier.

At this time the planet is in Pisces and rises just before 4:30 A.M., so that he should be easily visible just before dawn.

Venus is also a morning star and at her greatest distance from the sun—46 degrees—on the 18th. She is in the constellation Aquarius and rises at about 3:45 A.M. on the 1st and at 3:15 on the 30th of the month.

Mars is in Capricornus and rises about 2 A.M. He is approaching the earth and growing brighter, but is still more than 130,000,000 miles away. Nevertheless he is as bright as a star of the first magnitude. Jupiter is also in Capricornus and is in conjunction with Mars on the 23d when the two planets are less than a degree apart—Jupiter being to the northward. The morning sky about this time will present a fine spectacle. All the brighter planets will be simultaneously visible, for Saturn is in Libra and crosses the meridian at about 1:30 A.M. on that date.

Uranus is also a morning star, and in Pisces between Mercury and Venus, but is visible only with a telescope—at least in his present unfavorable position. Neptune is in Leo and observable in the evening.

The moon is in her last quarter at 4 P.M. on the 5th, new at 8 A.M. on the 12th, in her first quarter at 6 P.M. on the 19th and full at 7 P.M. on the 27th. She is nearest the earth on the 10th and farthest away on the 22nd. During the month she is in conjunction with Saturn on the 2nd, Mars on the 7th, Jupiter and Venus on the 9th, Uranus and Mercury on the 10th, Neptune on the 21st, and Saturn again on the 29th.

SOLD OUT!

"Sold out," said the newsdealer to the belated seeker after knowledge who applied at the newsstand last month for a copy of the Scientific American a few days after it was placed on sale.

"Sorry, but we have no more copies for sale," said the circulation manager the next day. "The last issue of the Scientific American is exhausted."

All of which only goes to show that even editors and publishers sometimes are surprised at the way the public takes to a magazine which rapidly is growing in interest and popularity.

In growing numbers men and women are finding in the Scientific American the one best means of keeping abreast of the times, of keeping informed of the tremendous strides forward the leaders of science and industry are making—steps that vitally affect the lives and habits of all of us. In growing numbers they are demanding it at the newsstands.

When you ask for your copy next month you may find it already has been sold to some one else. That very misfortune happened to many Scientific American readers last month; it is likely to happen to still more, for the Scientific American is winning new friends with every issue.

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

Inventors are the most interesting people in the world Their vision, their determination and their hard work are responsible for practically all the progress that mankind has made

These very qualities which make for success in inventing are the same qualities that often operate to the disadvantage of the individual inventor The inventor has vision, but he is likely to be visionary He has determination—and it is a virtue he certainly needs if he is to get anywhere—but he is likely to be obstinate He is not afraid of hard work, but too often this work is in the wrong direction.

In other words, the inventor is often not a business man, even though his rewards depend at least as much upon business ability as upon the merit of the particular invention. The following item is the first of a series of *Don'ts for Inventors* which we will publish in future issues.

I—Little Things Count

One of the most encouraging things about inventing is that it generally is the simple little ideas, ideas that any of us might have thought of, which make the most money The husband who watched the tedious efforts of his wife in doing up her back hair and then devised the wire hairpin made a far greater fortune than he probably would have made if he had invented a piece of complicated machinery

The little invention costs less to manufacture If you want to sell it outright or license it on a royalty basis, there are a far greater number of prospective buyers than there would be for something that requires elaborate means to produce Then, too, there is a wider market for the article itself; and although the price may be low, the large volume of business and the repeat customers will usually buy, more than make up for the initial price received for something that is more expensive. *Don't be afraid your invention is too simple to make money*

Salt Water Taffy

NO little boy would think of leaving the seashore without a bag of salt water taffy This universal habit is responsible for a business running into the millions of dollars It is a business which recently was in jeopardy, until the United States Supreme Court came to the rescue.

John R Edmiston, of Wildwood, New Jersey, in 1923, contended he was the originator of salt water taffy and for ten years prior to 1905 was the only one to manufacture it. The Patent Office registered "salt water taffy" as his trademark

Edmiston then notified all the other manufacturers of the confection to cease using the trademark and served notice that he would collect royalties on all taffy made since 1895 These royalties would have run into millions

About 500 candy manufacturers, chiefly along the Atlantic seaboard joined in the battle against Edmiston It began in August, 1924 Recently the Supreme Court ruled that the term "salt water taffy" is free to everyone and cannot be registered as a trademark

Imaginary Mills

WHEN is a mill not a mill? When it is a mill in name only, declares the Federal Trade Commission

The Western Woolen Mills Company, a corporation of Salt Lake City, has been selling knit underwear, sweaters, hosiery, shirts, blankets and similar merchandise direct to customers in other states. Despite the fact that its agents obtained orders on blanks which read, "I hereby request you to make to order the following goods and ship to me," the company never did own, control or operate any machinery or mill.

When the Federal Trade Commission issued a complaint for the alleged violation of the provisions of the Federal Trade Act, the company changed its name to "Western Woolen & Knit Goods Company." Nevertheless, the Federal Trade Commission went ahead with the case, in order that the law may be made clear, and now declares:

"The practices of said respondent, under the conditions and circumstances described in the foregoing findings, are to the prejudice of the public and of respondent's competitors, and are unfair methods of competition in interstate commerce."

American "Open Door" Policy

THE strong contrast between the policy of British manufacturers who so often refuse to disclose their processes and that of American firms is well demonstrated by the following note in a recent report of the Bureau of Mines. Says *The Engineer*: "The rapid stride in flotation concentration, it is noteworthy to point out, is due to the freer exchange of facts and data by the staffs of the larger mining companies and the patent controlling corporations, and by investigators in general. Generally speaking, one may visit any mining plant and by presentation of proper credentials be shown all that is going on or that is being done."

Yankee Brands in the Sudan

CIVILIZATION follows the trademark. The truth of this is impressed upon us by the registration of two marks just made in the Sudan, Northern Africa, by American firms.

One of these firms is the Transcontinental Oil Company, of Pittsburgh, which registers its widely known trademark "Marathon" for petroleum, kerosene, gasolene, lubricating oils and similar products. The other is the Bucyrus Company, of South Milwaukee, which registers "Bucyrus" for steam shovels, locomotives, pile drivers—machinery of all kinds, in fact.

Sudan trademark procedure is simple. A man simply registers his mark and it is published in the Sudan Government *Gazette* in both English and Egyptian. This serves as public notice of his ownership, and infringers act at their peril.

The Courts Aid the Canvasser

YOU probably are familiar with the canvasser who calls at your home and tries to sell you a colored enlargement of a photograph of one of the family. But did you know that he represents a gigantic industry and that the Federal Trade Commission has tried in vain to put an end to the hokum in his sales talk?

The case in which the Circuit Court of Appeals in Chicago renders a decision is that of the Chicago Portrait Company. The Federal Trade Commission ordered the company to cease representing falsely to customers that they were getting cut prices. The portrait company appealed to the courts. Judges Evans and Page, in the majority opinion, vacate the Trade Commission's order and say:

"The purchaser might have been deceived in some small way, but certain it is that he was not injured, nor was any competitor injured. From the forbidden acts there seems to us no possibility of injury to competitors, and we are of the opinion that they are neither within the letter nor the spirit of the act."

Patents Recently Issued

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Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

Adjustable Fastener Device.—Adapted to be used especially in connection with articles of wearing apparel, such as dresses coats or caps Patent 1565202 H. Reiter, R. 1608, 100 5th Ave., New York, N Y

Garment Supporter.—A detachable supporting device which may be applied to trousers for gripping the waistband of nether garments Patent 1566206 C A. Greene, 1674 Broadway, New York, N. Y

Supporter.—Of a flexible nature, which can be made to fit any person, and will keep in place without metal staves, straps or bands Patent 1565429 I. Dodge, 9 Farren Ave., San Francisco, Calif.

Undergarment.—For women, which is equipped with means for supporting the hose from the shoulders of the wearer, where corsets are not worn. Patent 1568917. Adeline C Peterson, 556 Breckenridge St, Buffalo, N Y.

Corset—Which may be from time to time adjusted so as to be varied in size throughout or at different sections. Patent 1568009 S. J. Newman, c/o I. Newman & Sons, New Haven, Conn.

Pneumatic Footwear Construction.—By means of which a high degree of resiliency is provided for the heel portion of ordinary type shoes Patent 1568405. J. C. Keller, 18 E Elm St, Chicago, Ill.

Shoe Structure—Which while closely simulating in appearance a turned-sole shoe, is free from many of the objectionable features. Patent 1569823 F. Maccarone, 906 Kent Ave, Brooklyn, N Y

Chemical Processes

Utilizing Sulphite Cellulose Lye.—As a fuel, by mixing the same with chloride of magnesium and vegetable waste, such as wood chips, and heating to between 150° and 200° C Patent 1564142 C. G. Schwalbe, c/o F Schwenterley, Koniggratzerst 59, Berlin S.W 11, Germany.

Lithopone Product and Process of Making the Same—Which includes quenching the lithopone in a solution of a soluble alkaline earth salt to form a coating, and then changing the salt into an insoluble one Patent 1565185 J. L. Mitchell, 17 W. 108th St, New York, N Y

Process for Weighting Silks.—Which comprises treating the fabric with solutions of acetic acid, lead acetate, and sodium phosphate Patent 1565390 A Pepper, 134 N 3rd St, Paterson, N J

Process for Treating Sulphide Ores and Concentrates.—For extracting the various ingredients in their metallic or salt form in one continuous process. Patent 1566370 M De Kayser, 113 Park St., Portland, Ore

Electrical Devices

Thermostatic Switch—Which may be utilized as a flasher or for any other purpose within a circuit to be automatically opened and closed, and in which a twisted flexible device supports a circuit breaker and is caused to move to open and closed position at an expansion and contraction of its support Patent 1561425. H R. Fernandez, 14 Villegas St, Havana, Cuba

Storage Battery—Having a spacer attached to each of the positive plates, to provide room for the active material that falls Patent 1564163 E H. Williams, 486 Schoonmaker Ave, Monessen, Pa.

Lamp Shade Frame.—For electric fixtures, such as bed lamps, which will not require the removal of the cord from either the socket or attaching plug. Patent 1564,170 K. C Berger, 367 1st Ave., New York, N. Y.

Electric Iron.—Adapted to iron materials of delicate texture, such as velvets, satins, etc, but may be used as an ordinary iron Patent 1563501. A. Ruelland, c/o Miss Pugh, 5 E 68th St., New York, N. Y.

Cigar Lighter.—Having an electrical heating circuit, closed when the lighter is pulled forward toward the smoker. Patent 1564072. J. M. Jackson, c/o Rope & Cordage Co, Parkersburg, W. Va.

Radio Coil Mount—Especially adapted for adjustably supporting radio-active elements for obtaining more perfect selectivity and volume in tuning operations. Patent 1565206. G. F. Rusicka, Bohemia, N. Y.

Method of Detecting the Presence and Approximate Location of Metallic Masses.—A device including moveable balanced ground antennas for determining direction of signals and locating metals. Patent 1564940 F. S. Chapman, c/o M. Y. Furney, Kenton, Ohio.

Radiodoll.—Within which is supported a part or all of a complete radio apparatus, capable of ready manipulation. Patent 1565145. B. L. Henry, Imperial Hotel, 31st St and Broadway, New York.

Illuminated Dial.—For radio apparatus, wherein the dial may be illuminated without illuminating the surrounding objects to any appreciable extent. Patent 1566069 W. C. and F. Bucholz, 87 Penn St., Brooklyn, N. Y.

Illuminating Attachment for Musical Instruments—For pianos or similar instruments, by means of which the flashing of illuminating means coincides with the rhythm of the music. Patent 1566202. H A. Giller, 90 Maurice Ave., Elmhurst, N. Y.

Electrical Switch—For use in many different ways, but particularly adapted for giving direction indicating signals in connection with motor vehicles Patent 1563,753 C. R. Krone, 410 28th St., Oakland, Calif.

Dry Battery.—In which the electrodes and the electrolyte are rendered active only when the battery is withdrawn from its container preparatory to use. Patent 1566927. D. Rosen, deceased, address Mrs. B. Rosen, Box 1, Ave "K," Brooklyn, N. Y.

Switch-Operating Device.—By means of which the electric lights in a sleeping room may be turned on simultaneously with the operation of an alarm clock. Patent 1567,104. M. J. and C. L. Beck, Route 3, St. James, Minn.

Thermostatic Control.—For an electric circuit that will automatically maintain water heaters, glue kettles and similar devices at a desired temperature. Patent 1566,699. E A. Scholtz, 4055 19th St., San Francisco, Calif

Electric Aerial Advertising Means.—In which an advertisement is suspended from a balloon having a revolving movement, the sign being visible from all points. Patent 1568011 C. S. Trippeda and A. J. Dichiaro, c/o Daylo Electric Light Co., 40 E. 2nd St., New York, N. Y.

Radiodial.—Having an attachment by means of which stations are so recorded as to facilitate the tuning in of the set. Patent 1567968. J. Lupo, Jr., 3636 Park Ave., Bronx, N. Y.

Fire-Alarm-Signal-Transmitting Apparatus.—In which whenever a fire alarm signal is sent over a circuit, a wireless signal is also transmitted. Patent 1567326. A. P. Lopez, P. O. Box 496, Palmer & Water Sts., Stonington, Conn.

Permutation Switch Lock.—For electric switches, necessitating the operation in a predetermined sequence of a group of elements, thus make the closing practically impossible by unauthorized persons. Patent 1568483. J. J. Tolbert, 577 North Kenmore Ave., Los Angeles, Calif.

Of General Interest

Combination Sink Stop and Drain.—Eliminates the dish pan, and many other utensils. Patent 1511018. Jacob Binder, 159 Moore St., Ludlow, Ky.

Mold-Forming Device.—In which the cast article will have a smooth appearance, for casting precious metal, articles of jewelry and the like. Patent 1563189. G. A. Hausherr, c/o Mr. Bolder, Bennington St., Newark, N. J.

Needle Threader.—Whereby the needle when dropped into the device, will automatically seat itself in proper position to receive the thread. Patent 1563223 W. Parsons, 631 Green Ave., Brooklyn, N. Y.

Process of Producing Color-Filled Embroidered Designs on Textile Fabrics.—Which does away with the use of the pantograph for producing the outline, the design being reproduced in any length or quantity. Patent 1563185. P. Gouled, c/o Independent Mfg. & Importing Co., 225 5th Ave., New York, N. Y.

Window Screen.—With means for adjustably securing the same to provide for any desired degree of raising or lowering the window. Patent 1563361. M. F. Henning, 5732 E. 14th St., Oakland, Calif.

Solar Attachment for Transits.—Capable of carrying out all the operations and observations which may now be achieved, without necessitating a series of delicate adjustments. Patent 1563484. J. M. Gunn, Laguna, New Mexico.

Stamp Holder.—Designed primarily for use by rural mail offices, for preventing sticking of the stamps in damp or warm weather. Patent 1563686. M. B. Bultman, 261 Broad St., Sumter, S. C.

Post Base.—For protecting from decay the part of a post which is near the ground and most liable to rot. Patent 1564109. L. Ponsolle, Angers, Maine-et-Loire, 16 Rue de Bel Air, France.

Sash Lock.—Establishing an adjustable locking connection between the upper and lower sashes whereby the same may be retained partially open. Patent 1564128 R. Curtis, Sr., 384 Princeton Ave., Jersey City, N. J.

Toothbrush Rack.—Which will support a maximum number of brushes in a minimum of space and maintain the bristles out of contact. Patent 1564119. J. H. Balmer, 259 Plane St., Newark, N. J.

Sample Display Folder.—Of book-like structure, having a display frame adapted to overlap any one of a plurality of sample fabrics. Patent 1564152. J. M. Thomson, c/o Sherman & Sons, 381 4th Ave., New York, N. Y.

Replaceable Tooth.—Whereby a porcelain tooth, and a backing, may be easily and firmly united. Patent 1564087. W. L. Mason, c/o George R. Lamb, 414 1st National Bank Bldg., Cincinnati, Ohio.

Chimney Protector.—For protecting the chimney top against weather conditions, and reinforcing the top layers of bricks. Patent 1563706. S. A. Hoffland, Box 624, Fennimore, Wis.

Paper Container.—Which will allow the use of heavy cardboard, and yet make the end member practically an integral portion of the body. Patent 1563063. G. H. Bartlett, 1648 21st Ave., San Francisco, Calif.

Holder for Baked Apples.—With means for holding the individual apple while it is being baked, the apple being served on the holder. Patent 1565077. M. G. Finn, 1822 E. 23rd St., Brooklyn, N. Y.

Adjusting Loop.—More specifically a clamping device for ropes and cables, which permits of ready adjustment, yet rigidly holds against accidental slipping. Patent 1565041. F. J. Arney, 423 E. 162nd St., New York, N. Y.

Phonograph Starting and Stopping Device.—So constructed that the phonograph may be automatically started by an alarm clock, and stopped as soon as the record is completed. Patent 1565158. L. Jurenka, 1263 1st Ave., New York, N. Y.

Incinerator.—For safely holding papers or other waste material while they are being burned, the device is constructed of woven wire. Patent 1565120. J. W Thompson, 15 Terrace Ave., White Plains, N. Y.

Canopy Holder.—Of the knockdown foldable type, which will serve to support a canopy of mosquito netting over a bed. Patent 1565191. V. P. Nelson, 264 Lexington Ave., New York, N. Y.

Siphon.—Having a flexible tubular member whereby a flow of liquid therethrough is obtained in a quick and positive manner. Patent 1564630. R. Saa, Box 306, Station "A," Auburn, Calif

Knee or Foot Rest for Shovels and the Like.—Providing a rest by which the weight of the operator can be applied in forcing the blade into the earth. Patent 1563528. S Rubio, 920 Sunset Blvd., Los Angeles, Calif.

Drafting Table.—For students in home use, the table being so made that it can be readily taken apart and packed into as small a space as an ordinary suitcase, an adjustable T-square is also included The inventor has been granted two patents, 1564358 and 1564359. P. Klein, 181 Glessner Ave., Mansfield, Ohio.

Wall Board Composition.—For use in building constructions, and as a substitute for wood in furniture production, the composition comprising sawdust, sodium silicate, whiting and molasses. Patent 1564706. J. W. Oelhafen, Tomahawk, Wis.

Smoking Set.—Combining receptacles for a package of cigarettes, book matches, and smoking refuse, adapted for use in automobiles or other vehicles. Patent 1566139. J A. Honegger, 2030 Palmetto St., Brooklyn, N. Y.

Spacing Fastener for Wire Screens—Used as reinforcing elements for cement mixtures applied to the face of a house of stucco finish Patent 1563785. I. Paterson, 1904 Ashby Ave., Berkeley, Calif.

Scaffold Horse.—Of knock-down adjustable type, having interlocking parts of tubular cylindrical form, easily moved from place to place. Patent 1566171 W. J. Spurr, 322 Crescent Ave., Leonia, N. J.

Key Holder—Which is extensible, having an attaching tab applicable either to a button or bolt, and in normal condition of comparatively short length. Patent 1566192. A. J. Forrest, c/o Ohio Express, 603 N. Dearborn St., Chicago, Ill.

Automatic Wake-up Doll.—Which when placed in its crib the eyes will remain closed for a suitable length of time, and will then automatically open. Patent 1566166 G H. Parsons, c/o Averill Mfg Co., Wales Ave and 143rd St., Bronx, N. Y.

Sadiron Holder—Which will properly grip the handle of the iron, and effectually protect the hand of the user. Patent 1566933. H. Toepfer, Everglade Ave. and Mohawk St., Little River, Fla.

Hair-Trimming Guide.—Whereby to insure a uniform shaping and cutting of the hair around and in front of the ears. Patent 1567011. J. Parziale, 8714 111th St., Richmond Hill, N. Y.

Watchcase Construction.—Forming a diversified setting in which the dial of a watch movement may be displayed Patent 1566976. D. Schmidt, 114 Fulton St., New York, N. Y.

Dolls' Eyes.—Of the moving type, which are self-sustained within the head without the use of plaster of Paris. Patent 1566908 L. H. Messinger, Jr., 198 Flanders St., Bridgeport, Conn.

Flexible Cement Composition.—Comprising eight parts of sand, four of cement, four of a calcium soap, and one of a zinc soap, forming a paint or plaster. Patent 1566917. O. Oleson, 370 Wadsworth Ave., Apartment 24, New York, N. Y.

Swimming Ring.—In the form of a hollow and inflatable construction with a head representing a swan or other fowl. Patent 1566858. E. A. Guinsburg, 302 Fifth Ave., New York, N. Y.

Sprinkler Head.—Which is adjustable for the purpose of varying the area of lawn sprinkled, and the control of water pressure. Patent 1564587. J. Kreiziger, 2217 W. 31st St., Los Angeles, Calif.

Siphon.—Whereby liquid can be siphoned without the usual necessity of applying the mouth to the tube to start action. Patent 1566916. T. Okihara, 50 N. Beretania St., Honolulu, Territory of Hawaii.

Toothbrush Holder.—Wherein a plurality of tooth brushes are suspended and protected when not in use, but may be readily removed Patent 1566880 J P Hainzi glanis, c/o Cutting, Phillips & Hale, 25 Broadway, New York, N Y

Screening Device.—Which can be readily applied to and securely held in ventilating openings without the use of nails, screws or like fastenings Patent 1564365. A A Newnham, 107 Bath St, Santa Barbara, Calif.

Awning.—In which the canvas may be drawn from one side of the window to the other, permitting ventilation and obstructing the sun's rays at various hours Patent 1566116 E Poulsen, 625 Milwaukee Ave., Chicago, Ill.

Toe Slipper—Of the type used by ballet dancers, made with a re-enforcing member at its toe to sustain the weight of the body on the toe Patent 1564607 G Meier, 818 Eastwood Ave., Chicago, Ill

Cuff Button.—Having two cooperating parts and novel means for causing the cooperating members to become released, the parts are entirely encased. Patent 1564657 G Wullum, 1733 N. Francisco Ave., Chicago, Ill

Siphon—By means of which a siphon action may be readily started and controlled, in discharging the contents of a bottle or jar Patent 1566753. P. H Kraetch, Astoria, Oregon.

Draftsman's Pounce Block—For preparing the surfaces of drawing or tracing cloth before working thereon, and preventing the pounce powder from flying Patent 1565670 F. Philip, Lompoc, Calif.

Advertising Device—Which has movable members adapted to be actuated by the wind to attract the attention of passersby Patent 1566739 H. R. Estes, c/o Mrs S A Dinwiddie, 7206 Lanhar Ave, St Louis, Mo

Method of Making Porcelain Articles—By which the production will be cheapened by the saving of time and labor, on an accurate and perfect product. Patent 1566841 E L Dillman, 42 Flushing Ave, Jamaica N Y.

Holder for Thermos Bottles and the Like—Readily mounted in any suitable place for the support of a thermos bottle in an upright position. Patent 1566698. L Saiger and M Russell, Johnstown, N Y

Concrete Shingle.—Which can be secured firmly in place in association with other shingles to produce a fireproof and leakproof roof Patent 1567946. C. F. Helflinger, Box 505, Hobart, Wash.

Hardware and Tools

A Burglar Proof Safety Lock Comprising a Movable Portion and a Wedge Shaped Keeper—Improved model Patent 1487328 Max Golden, c/o Wachs Bros, 35 Bleecker St., New York City

Saw—Made of stock material, and minimum number of parts, assembled and disassembled in the simplest manner Patent 1564105. A. F Ouellet, 106 W. 86th St, New York, N. Y.

Door Holder—Adapted to be actuated automatically to hold a door in open position until manually released Patent 1563795. W. Roberts, R D No. 9, Springfield, Ohio

Screw Jack.—Employing ball bearing screws, reducing friction to a minimum, and which made with a smaller lead, develops more power than ordinary jacks Patent 1565806. H. H. Jones, 20 E. Cota St, Santa Barbara, Calif

Wrench—For nuts, bolts or pipes, having a special form of adjusting worm which ensures proper engagement with the rack bar. Patent 1564411 J. H Fones, 1822 E 23rd St, Brooklyn, N Y.

Latch—Of simple form, by means of which a door can be opened merely by pushing on the knob, without turning it Patent 1565212. J. Sillick, 52 E 129th St., New York, N. Y.

Door Control.—Which will act automatically to hold a swinging closure in any desired position, it is practically noiseless in operation Patent 1565524. W. B Summerall, Box 2113, Atlanta, Ga

Tool-Holding Device—Adapted to be attached to the pocket of a garment for releasably securing tools and preventing their accidental removal. Patent 1566105 N E Gandrau, 408 E. Grand Ave, Watts, Calif

Underreamer Dressing Block—For holding an underreamer cutter in a perfectly upright rigid position without damage to the original form. Patent 1566483. G E Kraeer, Box 548, Wilson, Okla.

Combination Lock.—In which a plurality of tumblers is required to be arranged in a given order to permit the lock to be opened. Patent 1566820 F. Clark, Calle Juarez 35, Durango 3, Mexico

Awning Attachment.—For elevating or lowering awnings, so constructed that it may be operated from inside of a room Patent 1566450 W. A Tomlinson, Phoenix, Arizona

Door Bolt—Adapted to be carried by the door and engage the floor to positively prevent the opening of the door Patent 1566,805 B Ackerman, 114 W 19th St, New York, N Y

Lock Nut—Which insures the locking of the bolt but provides for convenient release of the locking means when desired Patent 1566830 F Clark, Calle Juarez 35, Durango 3, Mexico

Hammer In which an insert is provided for re-enforcing the handle at the head, preventing shrinkage and providing greater strength Patent 1565668 M Nicholls, c/o M. J Wolcott, Exeland, Wis

Combination Lock—Of comparatively simple construction, in which means is provided for readily permitting the changing of the combination Patent 1566884 R Larosa, 463 Catherina St, Ft Lee, N J

Roof Flashing—Which can be quickly applied, requires no nails or lath, prevents leakage, and adds to the life of the roof Patent 1566750 W Jacobson, 2011 W Division St, Chicago, Ill

Socket or Speed Wrench—In which yielding means are introduced in the socket tending to force the nut acted upon outwardly Patent 1566760 C B Michel, Oakland, Calif

Plastering Staple—Adapted to function as laths or furring strips for spacing the plaster receiving wire mesh from the sheathing. Patent 1566747 C Holloway, Jr, 950 Bryant St., San Francisco, Calif

Overshot—Designed to use cement for the purpose of binding the object being recovered from a well, yet provide convenient removal of the object when above ground. Patent 1567109 A Boynton, c/o Frontier Oil Co, City National Bank Bldg, San Antonio, Texas

Lock—In which there is provided a key operated series of tumblers and a pawl operated series of tumblers Patent 1567979 C E Northrop, deceased, Clara L Northrop, Administratrix, 419 Highland Ave, Dayton, Ohio

Doorknob—In which is incorporated as a central element, a mirror, protected against knocks or blows Patent 1567954 S Kalm, c/o J Chester Sons Co, 145 Grattan St., Brooklyn, N Y

Heating and Lighting

Water Heater—Which may be connected to a domestic boiler for quickly heating the water by means of a gas burner Patent 1566209 J G Haus, P. O Box 35, Weirton, W Va

Method of Heating Honey—By causing the honey to travel in a thin sheet while subjected to 156 degrees for a brief period, then rapidly cooling the same Patent 1565471. A G Kuykendall, La Mesa, Calif

Oil Burner—Having means for vaporizing the oil and forcing the vapor through a very small orifice, whereby the roaring of the burner is eliminated Patent 1564571 M Herod, R F D No. 4, Michigan City, Ind.

Gas Lighter—In the form of an attachment for gas stoves and comprises a pilot light and main burner with cut off for both Patent 1567962 C M Lee, 205 Pasadena Ave, Elyria, Ohio

Stove Burner and Water Heater—So combined that water may be boiled while the usual cooking operations are carried out, without the delay incident to separate operations Patent 1568853 J P Lane, 171 Clinton St, New York, N Y

Air Heater for Furnaces—Wherein heated air may be supplied above the bed of coals in the furnace, and may be readily regulated Patent 1569811 E Jordan, 1634 132nd St, Richmond Hill, N Y

Machines and Mechanical Devices

Tension Device for Shuttles—Which begins to function automatically as soon as the thread is placed in operative position, providing the desired tension. Patent 1565,187. C. F. Moore, c/o Schwazenback Huber Co, Bergenline Ave. and Oke St., West Hoboken, N J.

Smoking Set.—Constructed in such manner that a single cigarette and a single match will be discharged upon the operation of mechanism. Patent 1566175. J. Vaghi, Bethel, Conn.

Machine for Cutting Button Blanks. So constructed that it will be possible to use thereon shells of concavo-convex form. Patent 1558254. P F. Dusha, A Feyk, and E. Feyk, c/o V. F. Nekarda, 230 Fifth Ave., New York, N. Y.

Stapling Machine—For shoe manufacturers, having means for drawing the leather tight over the last as the staples are inserted. Patent 1563435. A. H. Prensel, Halifax, Pa.

Beam Tension Device for Knitting Machines—Capable of adjustment to any desired tension, and automatically maintained at that tension while the machine is in operation Patent 1564162. O C. Wiese, 1765 E. 19th St., Brooklyn, N. Y.

Automobile Parking Machine—By means of which a minimum of ground space is required for the accommodation of a large number of cars. Patent 1564100. J E Morgan, 5 Murdock Apts, West Lafayette, Ind

Cam Box for Knitting Machines—In which the cams are so arranged that the needles will work lower in respect to the sinkers, without damaging either Patent 1563788. J. P. Primm, c/o Rome Hosiery Mills, Rome, Ga.

Cooling Machine.—For use in the process of engraving, in what is called the burning-in step of an etching process. Patent 1560640. A H Antz, c/o Sierra Art & Engraving Co, San Francisco, Calif

Gummed-Tape-Sealing Machine—In which tape having an adhesive surface is drawn from a roll and moistened and torn off in suitable lengths. Patent 1563209. J. H. McIntire, 276 Jefferson Ave., Brooklyn, N. Y.

Wire Stretcher—For pulling wire screening taut when applying to windows or doors Patent 1565065 J B Doerr, 109 W. Washington St., Orlando, Fla.

Oil and Gas Separator.—For collecting and separating the gas from the oil as the commingled gas and oil come from the well. Patent 1565135. C. J. Wolfe, Yale, Okla.

Power Transmission Mechanism.—Particularly adapted for use with portable well drilling apparatus, driving the mechanism necessary in spudding in, drilling, casing application, and baling. Patent 1563514. J W Miller, 811 North Raymond Ave, Pasadena, Calif.

Cutting Machine for Printing Press Rollers—Which operates to simultaneously trim the ends, and circumferentially grooves the roller for dividing the surface Patent 1566184. C. M. Earley, 321 86th St., Brooklyn, N. Y.

Regulating Valve for Fluid-Pumping Apparatus—Which can be inserted in an ordinary pipe line between a liquid container and a pumping apparatus. Patent 1566147 C. S. Lenz and G E. Jupp, c/o American Marine Devices Corp, 400 W. 23rd St, New York, N. Y.

Automatic Control Winding Mechanism for Clocks—Adapted to wind the clock without interference with the normal operation, the winding being electrically operated Patent 1565705. J. M Boner, 225 Main St., Evansville, Ind.

Evenness Tester—For testing thread, yarn and the like, so that the weaver may know in just what portions the unevenness occurs. Patent 1566949 H. S. Wyckoff, 316 Hudson St., New York, N. Y.

Ratchet Mechanism.—Which is automatic in operation, and is particularly well adapted for use in reversible ratchet wrenches and the like Patent 1565473. W R. Lee, 1819 Main St., Galena, Kans.

Automatic Dispensing Device—For liquids, set in operation by the opening of a valve which will cause the operation of a motor for driving a pump Patent 1566591 C A Goldsmith and J F. Montague, Collingswood, N. J.

Water Motor.—In which revolubly mounted blades, against which a stream is directed to the upper portions, causes a whirl pool effect Patent 1566725. C A. Blume, c/o Whirl Pool Water Motor Co., Rocky Ford, Colo

Lift for Gin Breasts.—Which may be readily operated either by hand or foot, may be readily held in locked position or easily released. Patent 1567185. F. B Cumpston, Blooming Grove, Texas.

Liquid Vending Machine.—Having a coin-control mechanism, forming part of a pump, for dispensing a predetermined quantity of gasoline or other liquid. Patent 1567888. W. D. Ambrose, Nacogdoches, Texas.

Operating Means for Printing Presses.—Comprising an arm adapted to fall by gravity and initiate the operation of any ordinary press, and particularly the D roller type. Patent 1568015 J. A. and J. Williams, 23 Mt. Prospect St., Belleville, N. J.

Drill Puller.—Adapted to be applied to a drill rod for pulling the same when jammed, by utilizing the rotational movement of the rod Patent 1567504. G. Hinman, Box 137, Jerome, Arizona.

Watch—Which will be substantially dust-proof, and present a minimum number of parts thus being inexpensive to manufacture. Patent 1568003. A. C. Smith, c/o Elgin Watch Co, 20 W. 47th St., New York, N. Y.

Dishwashing Machine.—Wherein the dishes are moved through the washing solution with both circular and up and down movement. Patent 1567992. S and H. G. Dyktor, 813 No. Vista St., Los Angeles, Calif.

Liquid Vaporizer and Distributor.—For use with fans, by means of which air ducts compel a flow of air through a liquid container. Patent 1567957. M. B. Kesselman, c/o Amtorg Trading Co., 165 Broadway, New York, N. Y

Rubber Friction Drive Ring—Having a special split joint whereby the ring may be renewed easily and quickly without stripping the shaft. Patent 1566704. G. M. Stevens, San Francisco, Calif

Linen Cutting Machine.—For holding cloth, along a warp or weft thread, and making a straight cut with a power driven cutting member Patent 1568592. H. J. Fellman, 1418 W. 2nd St, Hastings, Neb.

Medical and Surgical Devices

Process and Product for Preventing Rust—In sterilizing surgical instruments, the bath comprising a weak solution of sodium nitrite and sodium sulphate. Patent 1565043 B. D. Avis, Box 130, Clarksburg, W Va

Combination Medical Apparatus.—For realizing the beneficial effects of light and heat, in a so-called electric light bath, the device can be folded for storage. Patent 1563736. C. B. Fink, Hotel Morton, San Francisco, Calif.

Tourniquet.—That may be conveniently carried in the pocket, having special means for quickly twisting and fastening the same in twisted form Patent 1566235. J. H. Sheehan, 663 7th Ave., Astoria, L. I., N. Y.

Device for Aiding the Hearing.—By means of which a person normally deaf, may be treated so that they may hear for the duration of the treatment. Patent 1566781. C. Carrol, Box 502, Chicago, Ill.

Method of Making Dental Plates.—Particularly porcelain plates, whereby the finished article may be readily removed from the mold without damage to the plate. Patent 1566840. E. L Dillman, 42 Flushing Ave., Jamaica, N. Y.

Rupture Pad.—So constructed that its use will exercise the rupture and stimulate the same to a degree which will promote a healing Patent 1568932. S O Trescott, P. O. Box 255, Battle Mountain, Nev.

Prime Movers and Their Accessories

Steam Engine—Which is flexible and reversible in operation, controlled by simple valve mechanism, and produces a maximum power from the motive fluid utilized. Patent 1564137 J H Livingston, Girard, La.

Steam Engine—In which a lever is within reach to change from full stroke to cut off, and the number of bearings is reduced and there are both economy and facility of operation Patent 1566201. C. R. Gibson, c/o J F Brunning & Sons, 10 Upper 1st St., Evansville, Ind.

Gas Engine.—Having a combustion chamber between a pair of opposed pistons which through rock levers and links operate a single crank shaft. Patent 1566843 R. E. Du Be, 259 Galopago St., Denver, Colo.

Ignition System.—Which causes distribution of the secondary current from a single coil to the spark plug of the Ford ignition system. Patent 1566888. G. Luckeman, Hoboken, N. J.

Piston.—Provided with a follower and fastening means therefor which will effectively prevent leakage of steam beneath the follower. Patent 1566951. A. Tickle, Standish Arms, 169 Columbia Heights, Brooklyn, N. Y.

Centrifugal Vaporizer.—Reducing a mixture of air and fuel, to a fine mist which will burn rapidly and completely in the combustion chambers. Patent 1566862. J. R. Halterman, Cairo, Ill.

Hydraulic Power Transmission.—In which the driving engagement of one shaft with another may be effected gradually with a cushioning effect, eliminating jolts. Patent 1568804. V. Arkin, 2638 W. Davison St., Chicago, Ill.

Rotary Engine.—Which insures a maximum utility of the expansive action of steam between the stationary abutment and a rotor connected with a driving shaft. Patent 1569791. J. W. Shepard, Box 844, Tucson, Arizona.

Pertaining to Vehicles

Oil Gage.—Which may be manipulated for observation of the oil level from a point on the outer side of the running board shield. Patent 1564535. E. Davis, 324 Roosevelt Ave., Syracuse, N. Y.

Automobile Locking Device.—Whereby a plurality of levers may be quickly locked to prevent operation and the device readily removed when not in operation. Patent 1566885. M. Laska, 1700 Tulane Ave., New Orleans, La.

Bumper Protector Cushion.—For association with any ordinary type of vehicle bumper, to prevent scratching or mutilating parts of other vehicles Patent 1566839. R. Denels, 675 5th Ave., New York, N. Y.

Reflector for Headlights.—Constructed to give full illumination yet at the same time so diffuse the light as to prevent glare. Patent 1566906. C. and A Matisse, 207 E. 133rd St., New York, N. Y.

Automobile Bed.—Of a foldable nature, readily adapted for use upon an automobile for camping purposes. Patent 1566612. E. V. Loustalot, Franklin, La.

Automobile Bumper.—Which is unusually resilient, while at the same time the construction is strong, and will not sag. Patent 1566991. J. Sonnenfeld, 22 Tompkins Ave., Brooklyn, N. Y.

Tractor Attachment for Burning in Bearings.—Which will afford facilities for making use of the motive power of the tractor to burn in the bearings of a motor. Patent 1561964. R. C., H. F. and E A. Whittman, 424 Parade St., St. Marys, Pa.

Curtain Light.—Particularly relating to a frame for securing the glass, whereby the frame and light are effectively held in a vehicle curtain. Patent 1562356. E. Mandel, 461 Central St., Brooklyn, N. Y.

Endless Runner for Motor Trucks.—Adapted for use with motor cars of every character, wherein an oblong or elliptical form of structure is provided. Patent 1561,-996. E. M. Perry, 649 Market St., Youngstown, Ohio.

Automobile.—With quick stopping mechanism, for preventing accidents, the device being automatically operated by contact with an object, or manually operated. Patent 1563214. S. S. Maran, 168 W. 96th St., New York, N. Y.

Trailer.—Which affords facilities for resiliently supporting a load above the axle so that no zig-zag movement will be caused. Patent 1562652. W. C. Nabors, Mansfield, La.

Convertible Body for Automobiles.—Readily converted from an open to a closed type, and wherein the glass panels are firmly supported in the closed type. Patent 1563,-023. P. H. Gaskins, 1207 Graham Bldg., Jacksonville, Fla.

Mechanical Glare Darkener for Automobile Headlights.—A manually operated shutter which will permit of sufficiently covering the fronts of the lights to prevent glare. Patent 1563297. T. J. Shonley, Box 826, Mount Ayr, Iowa.

Automobile Headlight.—Which will direct the rays forwardly and downwardly, so as to illuminate the road while preventing danger from glare. Patent 1563656. M. P. E. Radloff, Hustisford, Wis.

Timer.—In which the brush consists of a single piece of wire bent into a spiral, with novel means for advancing or retarding the spark. Patent 1563708. H. W. Gessell, Verndale, Minn.

Neutral Latch for Planetary Transmission.—By means of which unintentional movement of the fast pedal to low speed position, is entirely precluded. Patent [illegible],-778. R. E. Mudd, 715 E. 61st St., Chicago, Ill.

Automobile Signal.—Which may be connected to the windshield and be visible to those in the front or rear, either day or night. Patent 1564123. M. P. Clough and N. H. Noyes, Box 118, North Haverhill, N. H.

Seat Support for Tractors.—Adapted for use on the "Fordson" without dispensing with the seat supporting spring usually employed. Patent 1563824. E. O. Bachman, R. D. No. 1, Box 949, Santa Ana, Calif.

Tow Rod.—In sectional form whereby it may be easily and conveniently carried as part of an automobile equipment. Patent 1563880. J. Jacobson, R. 1, Box 50, Columbia Falls, Mont.

Gage.—Having accurate means to indicate the pressure within a tire, and means for automatically relieving excessive pressure. Patent 1563847. G. H. Hall, address D. D. Bell, Spreckles Bldg., San Diego, Calif.

Testing and Truing Device.—Especially designed for testing and truing connecting rods of the engines of motor vehicles, automobiles or the like. Patent 1563959. J. C. Taylor, Hermansville, Mich.

Tire Cover.—Comprising a casing made to conform to the outlines of the tire and split transversely to be adapted to be sprung on. Patent 1563760. M. R. Loetscher, 727 Bedford Drive, Beverley Hills, Hollywood, Calif.

Direction Signal for Motor Vehicles—In which any one of a plurality of indications can be given, visible from the front or rear, and selectively illuminated. Patent 1563494. E. A. Jensen, 726 De La Vina St., Santa Barbara, Calif.

Arrangement for Parking Vehicles.—Which allows of the greatest possible number of motor vehicles being parked in a minimum of space. Patent 1563929. F. E Reinhold, 7470 Clinton St., Los Angeles, Calif.

Vehicle Body.—In which the fenders are an integral part of the body, and the foot boards are eliminated, no portions projecting from the body. Patent 1563808. R. L. Southern, Oakland, Calif.

Tire Mold.—Readily assembled and disassembled, for vulcanizing pneumatic tires by what is known as the "air bag process." Patent 1566259. A. R. Colvin, c/o Combination Rubber Mfg Co., Trenton, N. J.

Radius-Rod Assemblage.—So constructed that provision is made for a ready renewal of one or more of the rods should occasion require. Patent 1566207. L. H. Griggs, 621 W. Jefferson St, Mishawak, Ind.

Tractor-Operated Cultivator.—Constructed so that the tractor is back of the cultivator and pushes the same, enabling the operator to readily see the crop. Patent 1566229. G. H. Scanlan, c/o J. A. Sheehan, 44 Court St., Brooklyn, N. Y.

Designs

Design for a Textile Fabric.—This inventor has been granted four patents for fabric designs. Patents 68666, 68667, 68668 and 68669. I. Strauss, c/o Rosenstein Strauss Corp., 151 W. 36th St., New York, N. Y.

Design for Leather or Similar Article.—Patent 68818. F. A. Kolb, c/o Geisman, Musliner & Brightman, 27 Spruce St., New York, N. Y.

Design for a Hand-Bag Frame.—Patent 68853. W. F. Goldsmith, 391 Mulberry St Newark, N. J.

Design for a Hand-Bag Frame.—The inventor has been granted two patents, Nos 68906 and 68907. W. T. Goldsmith, 391 Mulbury St., Newark, N. J.

Design for a Boudoir Cap.—Patent 68,884. W. J. Turoff and E. A. Besancon 1076 Intervale Ave., Bronx, N. Y.

Design for an Emblematic Pin.—Patent 68847. N. L. Bourgeault, c/o Rosi Bros., San Francisco, Calif.

Design for a Statuette.—Patent 68598 Irene H. Rundquist, 4907 First Ave., Lo Angeles, Calif.

Design for a Lighting Fixture.—Patent 69015. E. J. Dietzmann, 894 So. Figueroa St., Los Angeles, Calif.

Design for a Dispensing Cabinet or Similar Article.—Patent [illegible]. R. A Norton, 696 W. [illegible] St., New York, N. Y

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Portable Lamps; their design and use 2 15

Foundations of the Universe 3.15
Presents popularly and systematically the foundations of the universe as it now appears. The author confines discussion chiefly to established facts and gives only glimpses into the realms that are speculative at present.

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By G. L. Hosmer
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These authoritative and fascinating tales of discovery, invention and research, give one a quick and conclusive résumé. Fifty subjects of wide range are covered. Published by Williams & Wilkins Co. $1 10 postpaid

Superpower—Its Genesis and Future
By W. S. Murray

The Superpower movement by the chairman of the United States Government's Superpower Survey Its national, economic, social and political side as effecting transportation and commerce Published by McGraw Hill Book Co $3 20 postpaid.

Best Humor of 1925
By N. H. and H. S. Dole

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[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]

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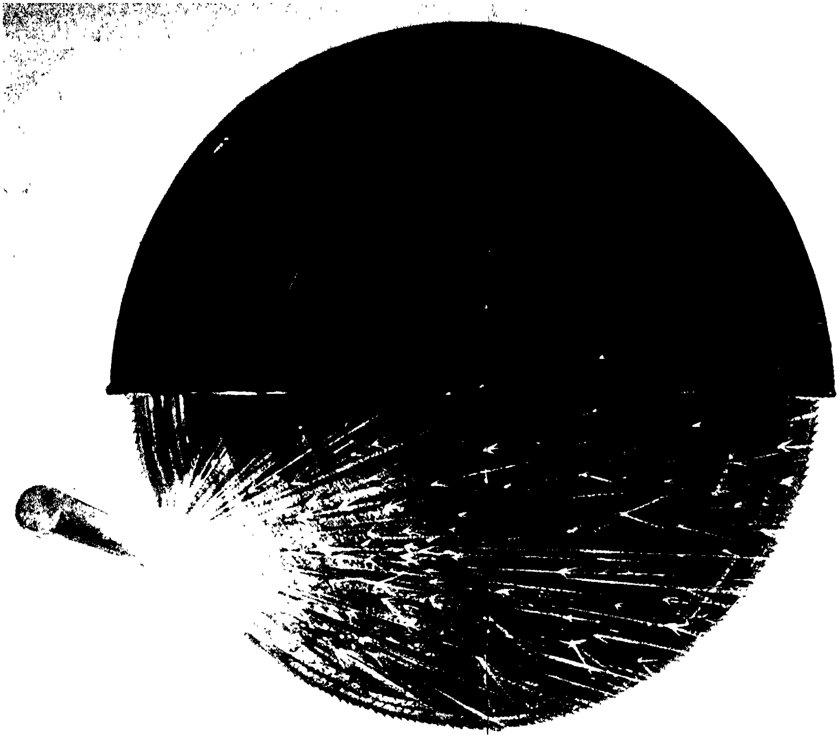

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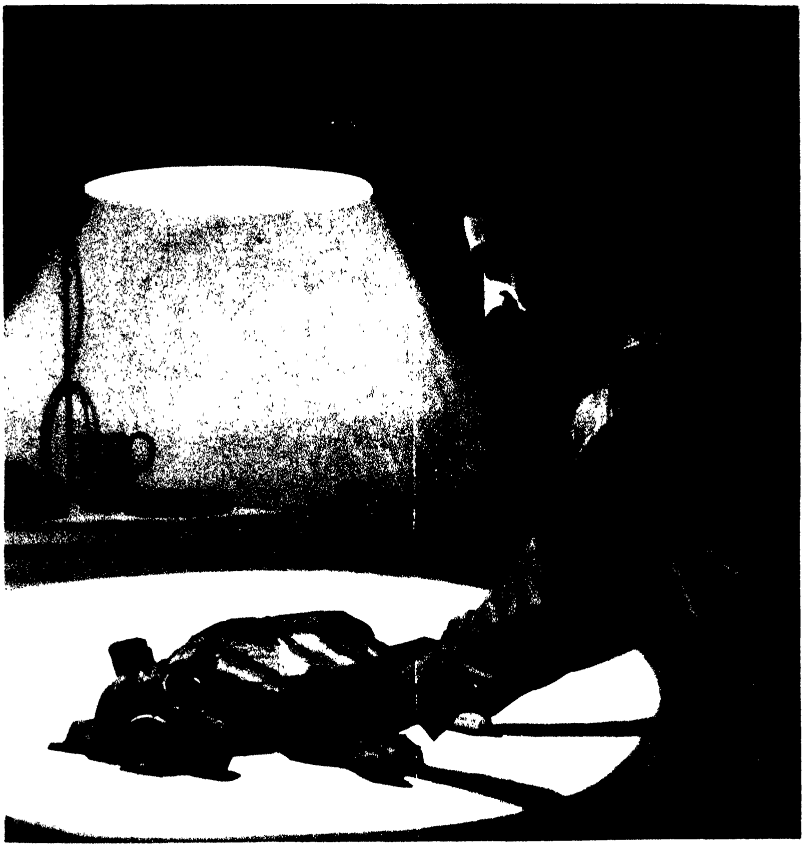
SCIENTIFIC AMERICAN

MAY 1926

29 MAY 1926



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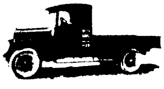
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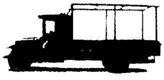
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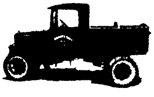
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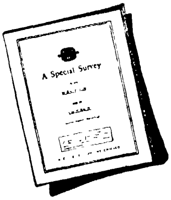

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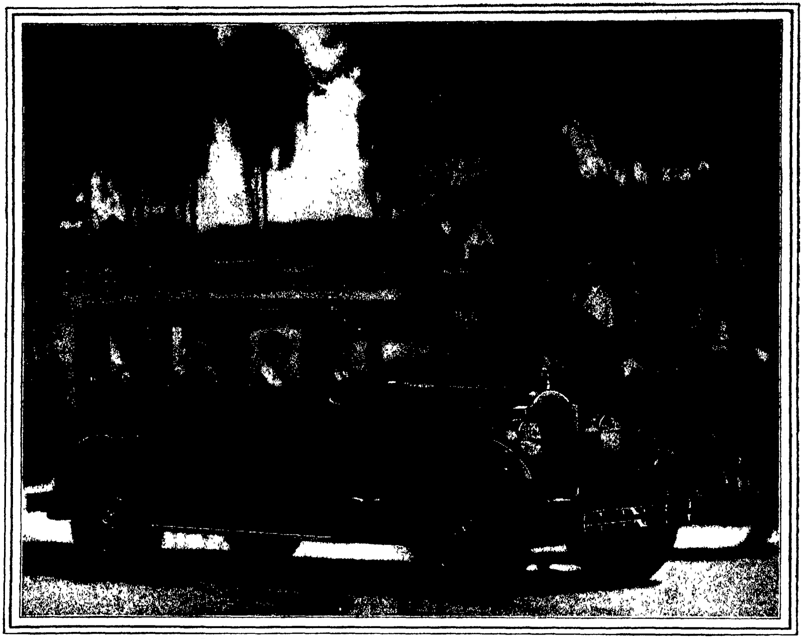

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, MAY, 1926 EIGHTY-SECOND YEAR

29 MAY 1926

PRIZES

EVERY year, the United States Naval Institute offers a prize for the best essay upon some naval subject. There is keen competition for this prize and it serves to bring forth some ably-written and very illuminating work. It gives us much pleasure to announce that the prize essay for 1926 was won by our London correspondent—Mr. Hector C. Bywater—who has come to be recognized as one of the leading, if not the foremost, lay authority on naval matters today. His essay, entitled, "The Battleship and Its Uses," is a concise and compelling argument for the retention of the battleship as the main arm of our naval defense. From his final summing up, we select the last of six propositions, which reads as follows:

"When the torpedo has acquired the range and precision of a 16-inch gun; when submarines have become as swift, as seaworthy, and as habitable as big surface vessels; when the radius and carrying power of aircraft have increased tenfold, and bomb-dropping is as accurate as gun practice: then, but not till then, will the primacy of the battleship be endangered.

EXPERIMENTS

WHETHER we do it to save money or not, most of us get a lot of satisfaction out of making useful things at home, doing scientific experiments, and so on. With our own hands we create the thing previously conceived in our brain, and the thing thus becomes a part of ourselves.

It is with this in mind that the Scientific American has secured Dr. H. H. Sheldon, Chairman of the Department of Physics at Washington Square College, New York University, to conduct a research department for its readers. From time to time he will present some experiment in science, pure or applied, that can be conducted by the intelligent amateur who feels that he would like to give his spare time to something intrinsically more satisfying than the reconstruction of a Ford into a wheelbarrow, and perhaps a little more difficult. Incidentally there are quite a few researches in science that require large numbers of experiments rather than especially trained experimenters.

You are invited to inquire, suggest, criticize and correspond with Professor Sheldon freely. This month he tells how to correct an auditorium having poor acoustics, a neat little job for the man that likes to tackle a real problem. There is at least one such auditorium in every community, but remember the job isn't to be done simply by stringing a few puerile wires across the rostrum.

In This Issue

What Shall We Do About It?

Unless we take pains to provide more scientific workers, our science, our industry and our mechanical civilization is threatened. We must go to the root of the trouble. On page 295 a noted naturalist does this.

More Fish, Fewer Mosquitos

Nowadays about everybody knows that mosquitos transmit malaria and yellow fever. Then get rid of the mosquitos. How? Drain the marshes, say some. Use crude oil, say others. Good, also costly. Prof. David Starr Jordan has an easier method and a far cheaper one. Page 296.

Man's First Tools

As our ancestors evolved in body their culture also evolved. Which of these evolved the faster? Did the two keep pace? These things and others are answered by a well-known prehistorian, Professor MacCurdy of Yale. Page 295.

Fighting Off the Bombing Planes

"A positive and highly efficient system of anti-aircraft defense will be realized during the coming year," declares Col H. E. Cloke of the Coast Artillery Corps. Commencing on page 302, he tells how army scientists are succeeding in sealing the doom of attacking airplanes

More and More Powerful Broadcasting Stations

What is the long-distance skip-effect? WJZ, the great new super-station employing fifty kilowatts, has already played some queer radio pranks, puzzling the radio engineers. On page 306, Mr. Orrin E. Dunlap, Jr., describes the equipment with which engineers will strive to solve these problems.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 360.

For Next Month

Speeding Up Nature's Processes

That is what Luther Burbank, the noted producer of new plants, really does. What Nature accomplishes in a million years he accomplishes in a summer or two In next month's issue Mr Burbank writes interesting sidelights on some of the remarkable things he does.

What Makes the Sap Rise in Trees?

Did you ever stop to wonder what force pulls and holds tons of sap high up in the trees? We know that trees give off water through their leaves by constant evaporation. Therefore more water must keep rising. Next month Dr. D. T. MacDougal, noted plant physiologist, will explain.

A New Plan to End Auto Congestion

H. W. Slawson, automotive authority, urges a new method that promises to give us all the room our motor cars need on city streets. It means greater efficiency, safety and comfort.

Other articles on The Earth's Internal Heat; Boy Scouts as Scientists; A Precision Balancing Machine; X Rays and Atoms; An Analysis of the Federal Budget; Annapolis; A New Type of Gas Holder; Radio; Astronomy.

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CIVILIZATION

SOMETIMES we are so close to a thing that we cannot make out its full significance We just take it for granted. Such a thing is the phenomenon which we call "civilization." What is civilization? A remarkable composite of human advances. But where did they come from? Were they in the predestined order of things? Were they bound to come sometime? Not at all. Given a few different circumstances, perhaps involving an element of luck, and man might have lived on and on a million more meaningless years into the future as a savage But somewhere conditions became just right for a limited group of uncivilized men to "invent" civilization Professor G Elliot Smith, who contributes an article to the present issue, believes this discovery was made in prehistoric Egypt. The rest of the world copied.

CREATION?

LAST fall when Professor Millikan announced the remarkable results of his research on the new cosmic ray he hinted at several hypotheses that might be advanced to account for its origin Said he, "Professor MacMillan of Chicago will wish to see in it evidence for the condensation into matter out somewhere in space of the light and heat continually being radiated into space by the sun and stars," and, he added that this would be, "an altogether permissible speculation"

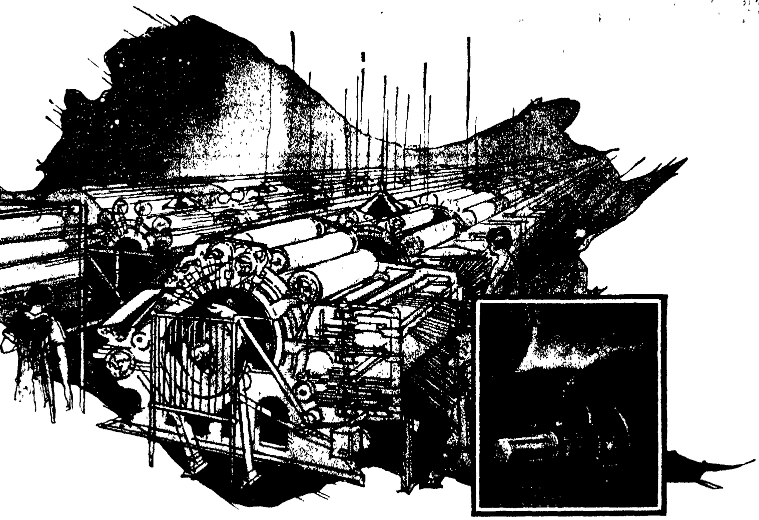
Professor MacMillan was not long in making good on Professor Millikan's prophecy, for the present issue of the Scientific American contains the statement of the MacMillan theory, just as foreshadowed by the noted atomic physicist.

ILLUSIONS

ILLUSIONS? Yes, we all have them, only yours and mine are different ones Perhaps illusions and "old wives tales" *thrive least in the mind of the* trained scientist. His rigorous thinking discipline kills them Even at that, a few scientists fall prey to them. We are acquainted with one scientist who will not walk under a ladder! He says this taboo is founded on actual fact—a pail of paint might descend Finally he admits being plainly superstitious.

The fact is, it is more pleasant for most of us not to think straight. We all like miracles and we love our other little irrationalities dearly.

This being characteristic of human nature we do not envy the author of the iconoclastic article on "Nature Faking," in the present issue. His mail will probably sizzle.



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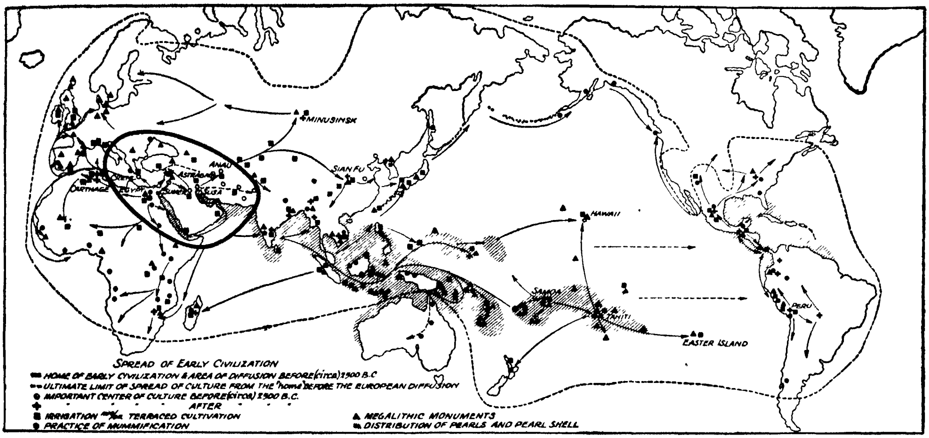
MINUSINSK
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SIAN FU
HAWAII
SAMOA
TAHITI
EASTER ISLAND
PERU
SPREAD OF EARLY CIVILIZATION
HOME OF EARLY CIVILIZATION & AREA OF DIFFUSION BEFORE (circa) 1500 B.C
ULTIMATE LIMIT OF SPREAD OF CULTURE FROM THE "home" BEFORE THE EUROPEAN DIFFUSION
IMPORTANT CENTER OF CULTURE BEFORE (circa) 1500 B.C.
" " " " " AFTER " " "
IRRIGATION AND TERRACED CULTIVATION
PRACTICE OF MUMMIFICATION
MEGALITHIC MONUMENTS
DISTRIBUTION OF PEARLS AND PEARL SHELL

THE GENERAL ROUTES BY WHICH THE CIVILIZED CULTURE INVENTED IN ANCIENT EGYPT SPREAD THROUGHOUT THE WORLD

Did civilized culture start in one place and spread, or did it start up independently in several places? Here is a rock on which ethnologists split The majority argue for several independent origins. The growing minority, of which the author of the article below is the recognized leader, argue for one place of origin and subsequent diffusion The map above depicts the spread of early civilization from ancient Egypt, while Professor Smith's article demonstrates it by tracing certain peculiar types of ships through various periods and to various places

Ancient Mariners and the Spread of Early Civilization

By Professor G. Elliot Smith

University of London

PERHAPS the strongest confirmation of the reality of the widespread diffusion of culture that began as soon as civilization itself was invented is provided by ancient ships and their survival in modern times. For the very business of a sea-going ship is to travel abroad and establish cultural relations with countries beyond the frontiers of the ship-builders' homeland. Fortunately, there has survived in most parts of the world ample evidence of the range of particular types of ancient vessels, the invention of which can be assigned to perfectly definite periods in time.

In very remote times, men were able to cross streams with the help of logs and floats of various kinds, and eventually by means of dug-outs. The mere fact that the ancestors of the Aboriginal Australians were able to make their way into Australia many centuries ago—exactly how long ago we have no evidence to decide—implies that these primitive people must have crossed one or more sheets of open sea.

In very early times many varieties of floats were invented by different peoples. The Babylonians made great earthenware pots, such as are still used in Mesopotamia today. They also made rafts, the buoyancy of which were secured by means of floats, either goat-skins distended with air, or pottery vessels. But it is a very interesting and significant fact that most of the ancient boats, and especially sea-going ships, found in almost every part of the world conform in most cases to one very distinct type, the history of which can be discovered in Egypt.

In order to cross the Nile, the Egyptians, certainly as early as the fourth millennium, nearly sixty centuries ago, constructed floats by tying together bundles of papyrus. These floats assumed a very characteristic form, which was determined by the nature of the material and the method of construction. When the Egyptians attempted to make more substantial and larger craft, and replaced the fragile papyrus by logs of wood, they still retained the old form of the papyrus floats and used the same method of construction; that is, they tied together the logs with string and rope, so that they did not speak as we do of "building" but of "tying" a ship.

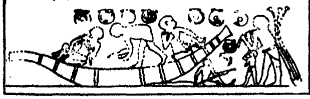
The Ship Was Invented in Egypt

The peculiar form of the stern and of the prow of these early ships was determined by such considerations as I have mentioned, and afford irrefutable evidence that the invention of ship-building was made upon the Nile, and that at first timber did not enter into the composition of the vessels.

When the Egyptians began to build more substantial ships they first used the sycamore wood of their own country; but from such experience they soon learned to appreciate the need for better material for their work. In fact, the earliest sea-going expeditions of which we have any record had for their object the getting of timber from the Lebanons for ship-building as well as for other purposes. What most people who have discussed this problem seem to have overlooked is the fact that these great undertakings would not have been made except by a people who had already learned to appreciate the value of good timber after using the poorer material of their own country.

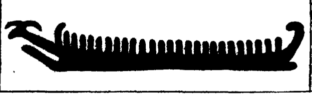
It is a very remarkable fact that writers on the early history of civilization—even, in some cases, scholars perfectly familiar with the Egyptian evidence—make the statement that the ancient Egyptians were not given to maritime adventure. Before the time of the Cretan ascendency in seamanship, the only people of antiquity who were known to have built sea-going ships (the ships of the Cretans were clearly imitations of Egyptian ships) were the ancient Egyptians themselves. The archaeological evidence is emphatic that the Egyptians were in touch with Crete, which necessarily involves the fact that they were trafficking with Crete by sea.

But the Egyptians have put on record not only the fact that they regularly sent expeditions on the Syrian coast (and right down the Red Sea as far as



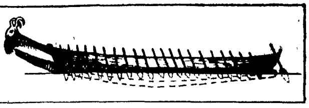
ANCIENT EGYPTIANS MAKING REED FLOATS

Six thousand years ago the Nile navigators originated the raised prow and stern. It has come down to our times



LIKE THE SHIPS OF TUT-ANKH-AMEN'S DAY

This Egyptian type of ship was found engraved on rocks in Sweden. Note the distinctive type of raised prow



A SIMILAR MODERN TYPE FROM UGANDA

Compare this craft with those at the left The ancient Egyptian type of craft spread far and wide

Bab-el-mandeb and beyond), but they have also left us the earliest stories of the experiences of travelers by sea. As Professor Maspero stated some thirty years ago: only the most inveterate prejudice could blind us to the fact that the Egyptians were the great seamen of early civilization.

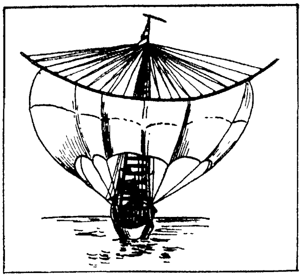
The types of ships invented by the ancient Egyptians reveal a number of peculiar and characteristic features that enable us to distinguish those belonging to definite historical periods. For example, at the time of the first Dynasty, a very peculiar type of vessel was being built with a great upward projection in front of the bow, to the top of which was attached a pair of horn-like appendages. The interest of this peculiar appendage to the ship is that the natives of East Africa now living on the shores of Lake Tanganika are still building ships with this identical peculiarity, a remarkable illustration of the conservatism of primitive people.

The earliest sea-going ship with the form of which we are at present acquainted goes back to a remote period in Egypt, about 2800 B. C. This type of vessel, with all its curious peculiarities of detail, is being built at the present day in the island of San Cristoval at the southern end of the Solomon group in Melanesia. A slightly later modification of this type, with a very peculiar high stern, an A-shaped mast and distinctive rigging is still preserved intact in Burma, where vessels, conforming strictly to a model that became extinct in Egypt (where it was invented) more than forty centuries ago, are used today to bring rice down to Mandalay

How Civilization Reached the World

Coming to a later period, we find a distinctive type of ship used by the officers of Tut-Ankh-Amen to collect tribute, not only on the upper reaches of the Nile in the Sudan, but also by sea from the coast of Syria and the isles of the Aegean. These ships, made in the 14th Century B. C., are of peculiar interest to the anthropologist because the earliest representation of a sea-going ship in Western Europe (engraved on rocks in Sweden by the people who introduced the Bronze Age culture to Scandinavia, an event to which Professor Montelius assigns the date 1000 B. C) is a perfectly definite illustration of the type of ship used by Tut-Ankh-Amen's seamen. This type of vessel is still being made at the present day by the natives of Uganda.

The discovery has recently been reported of ancient pictures of ships carved upon inland rocks in New Zealand, which differ in type from the known Maori boats, and are described by their discoverers as "resembling Greek galleys, with ramming beak and boarding platform." The photographs of these sculptures, like those of the Early Bronze Age in Sweden, leave little room for doubt that the same type of ship (that distinctive of the 14th Century B. C., in Egypt) was the model for these pictures.


BURMA'S PICTURESQUE CRAFT

The same type of vessel, with identical form of hull, mast and rigging, was used in ancient Egypt, 2600 B C

And so passing down the ages one can establish an unbroken chain of events to prove that the types of ships used at successive periods by Cretans, Phoenicians, Romans, Arabs, Indians, Malays, Chinese, Melanesians, Polynesians, the Pre-columbian people of Central and South America, and in medieval and modern times by the great European sailors, all exemplify the persistent influence of the naval architects of ancient Egypt, who determined the form and the method of construction of the ships and developed the rudiments of seamanship.

One must not assume that primitive people overcame the terrors of the sea and all the difficulties and displeasures of sea-travel simply from the spirit of idle adventure. It required a very powerful incentive, involving the question of life and death and the issue of prosperity or adversity to impel men to risk so much.

The Egyptians went to Syria to get timber and resin, partly because they had begun to appreciate the economic value of these materials, but mainly because these substances were used for the protection and preservation of the bodies of the dead, and thereby were regarded as divine in the sense that they were the instruments for perpetuating the bodies of the dead, which was at first regarded as the essential condition for the prolongation of the dead man's existence. Similar motives inspired expeditions down the Red Sea to East Africa and Southern Arabia where even more valuable preservative materials were found.

But it was not long before the quest of other things came to play a part in the process: gold and copper ore, a variety of spices and precious stones were all being sought after more than forty centuries ago, not precisely for the purposes for which men have been searching for these substances ever since, but primarily because they were regarded as divine, in the sense that they confer on mortals the boon of immortality. It was this magical factor that gave the glamor to the search for these materials. It has prompted men throughout the ages, right up to the time of Christopher Columbus, to seek for the "Islands of the Blest" and the "Earthly Paradise" where gold and jewels and other precious substances could be obtained in abundance.

By such means, more than by any other, the world in ancient times became linked together by a bond of common endeavor, and there were diffused throughout the whole world the germs of one common civilization.

An Important Scientific Question

I have not attempted here to give bibliographical references for the literature, as it is so immense in extent. In 1917 I attempted to do so in a pamphlet entitled "Ships as Evidence of the Migrations of Early Culture" *(Manchester University Press)*. I gave a summary of this more extensive paper in an article, "Ancient Mariners," in the *Journal of the Manchester Geographical Society*, 1917, which was still further summarized in Chapter XII of my book "The Ancient Egyptians," 2nd. Edition (Harpers, 1923), see p. 177. In Chapter V of my book "Elephants and Ethnologists,"* 1924, a brief account is given of the evidence of ancient maritime adventure in the Pacific Ocean, with the object of demonstrating how intimately the coasts of America were linked up with Eastern Asia, the Malay Archipelago and Oceania during the first twelve centuries of the Christian Era.

An independent demonstration of the vast significance of ancient Egyptian ships and shipping has been given by Mr W. F. Egerton in the *American Journal of Semitic Languages and Literature*, Vol 39, 1923.

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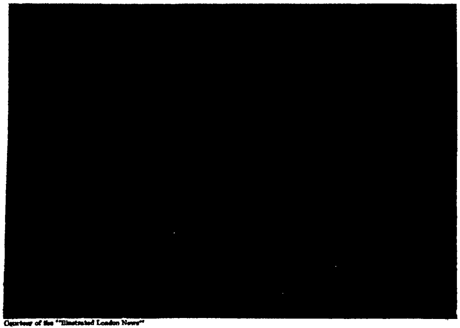
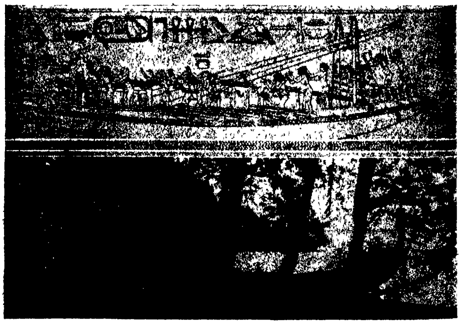
* Reviewed in Scientific American, January, 1926. See pages 8 and 11 —EDITOR


Courtesy of the "Illustrated London News"

ROCK PICTURES, RECENTLY DISCOVERED IN NEW ZEALAND

Here again is the raised prow and stern. The same general type of ship was distinctive of Egypt in the 14th Century B. C. Thus it has spread thousands of miles to the east


ANCIENT EGYPTIAN AND MODERN MELANESIAN SHIPS

ABOVE: *the earliest known picture of a sea-going ship, built in Egypt about 2800 B. C.*
BELOW: *the same type built at the present day in the Solomon Islands*

How Can We Produce Scientific Workers?

By T. D. A. Cockerell

Naturalist, and Professor of Zoology at the University of Colorado

“AT eight and one-half years old, I went to Mr. Case's school. By the time I went to this day-school, my taste for natural history, and more especially for collecting, was well developed. I tried to make out the names of plants, and collected all sorts of things, shells, seals, franks, coins and minerals. The passion for collecting—which leads a man to be a systematic naturalist, a virtuoso, or a miser—was very strong in me and was clearly innate as none of my sisters or brothers ever had this taste.”

CHARLES DARWIN.

“As to my interest in biology, I can trace it, I think, to two very trifling facts. I doubt if I had or have any *special* aptitude for it, but I have a natural love for *classification* and an inherent desire to *explain things;* also a great love of beauty of form and color. The two slight facts are these. When a boy at school, I heard a Quaker lady say that she and some friends had found the ‘monatropa’ which was quite a discovery as being before unknown in the district. This, and hearing the names of other flowers referred to as rare, made me think it would be very interesting to know the names of all the plants that grew wild. . . . The other incident was meeting H. W. Bates at Leicester and being started by him as a beetle and butterfly collector.”

ALFRED R. WALLACE.

Within the last quarter of a century, there has been an enormous increase in the number of college students in America. At the same time, the applications of scientific discovery and invention have changed the very aspect of our civilization. According to the United States Public Health Service, the annual death rate per hundred thousand in the United States has dropped in 20 years from 1,755 to 1,288 The applications of science are keeping us alive, raising our standard of living, and bringing us conveniences and luxuries previously undreamed of. Large sums of money are given to scientific institutions and some of the results of their activities are eagerly received by the public and widely discussed.

More Help for Pure Science

In the face of all this, it seems superfluous to ask how we are to produce scientific workers. Have they not been produced in ample numbers, and are they not working day and night to bring forth still other wonders for our delectation? Is it not true that the crop is ripe and being harvested, while we, the public, have only to present ourselves at the banquet table to be fed?

Actually, the matter is not so simple or satisfactory. The material benefits of science are not the only benefits. If we study any one branch of science, we find that the active and fruitful research workers are extremely few, except in those departments which are stimulated by commercial profit. Look at it from any angle and you have the spectacle of a very small minority feeding the great multitude, often under difficulties. This minority is so efficient that progress is rapid, perhaps more rapid than is altogether good for us. In the meanwhile, the people as a whole have little of the true scientific spirit such as animated those great naturalists of the past century, Darwin and Wallace. So little indeed, that they will not even create adequate faculties for those who are actually doing the work.

In my special field of zoology, there is not even a catalogue of the animals of the United States. No serious attempt is made to completely organize the knowledge we possess or extend it according to a general plan. The existing journals are having a hard time to exist and often have to be subsidized by their editors. The publication of the results of research is a problem which is daily becoming more acute. There are important groups of animals which are being studied in this country by one, two or three people, some by none at all.

But if so, what of it? Have we not the radio, the airplane, the moving picture, and a thousand other things, and what does it matter how many kinds of beetles are living in New York State, or how they are related to one another, or how they came to be where they are? Let us have some sense of proportion and cease to worry about facts which, left to themselves, will assuredly not worry us.

How to Create Scientists

Science, a comparative newcomer in human history, is remaking our world. It is doubtless providing an unimaginably brilliant future for mankind. Who, then, are they that shape its course, holding within their grasp our destinies? They are a mere handful of men, a few scant thousands out of two billions of humans, few of whom are even aware what is being provided for them.

Science will pay back inconceivable riches, therefore let the world invest more deeply in it; first we must produce more scientific workers. How? By planting scientific thoughts in the minds of our children. How this worked out in the case of Darwin and Wallace, Prof. Cockerell demonstrates by the opening quotations.

This cynical attitude is not peculiar to the masses; indeed, it finds clearest expression among those who are generally considered to be highly educated. One of the best men I ever knew, a college president, felt exactly that way. In attempting an answer, I must accept the pragmatic attitude and agree that the things mentioned are of no consequence if it is a fact that they furnish nothing of value to mankind I will not even take cover under the familiar retort, that as Franklin said, no one can estimate the potential value of a new-born baby. In this case, I will consent to infanticide if it can be established that the infant has no value at the present time. But this is a doctrine, unspeakably odious to its mother, who daily and hourly receives benefits of a transcendental nature.

Perhaps the analogy of the mother may serve to clear our thinking. We maintain, in fact, that scientific interest and activity are worth while as direct sources of pleasure and intellectual culture. They make the man, without which as Edwin Markham said, “these cities glorious” are of no avail. It is hardly too much to say that the moral benefits of science are much more important than the material ones; and it may be true in a new sense that if we seek the kingdom of heaven first, all else shall be added unto us.

The Rev. William Kirby, an eminent entomologist, wrote in 1800: “The author of scripture is also the author of nature and this visible world, by types indeed and symbols, declares the same truths as the Bible does by words. To make the naturalist a religious man, to turn his attention to the glory of God, that he may declare his works in the study of his creatures, see the loving kindness of the Lord, may this in some measure be the fruit of my work.” While we no longer use the phraseology of the Rector of Barham, it still remains true that the study of the work of nature is an efficient means of education, if by that term we mean the development of the desirable qualities of mankind. It is, as the good Rector maintained, the path to true religion, if that word implies a sense of the wonderful order of the universe which we must understand if we would successfully govern our own lives Thus, and not otherwise, may we attain virtue In that sense, the scientific and religious attitudes are one, and we can look back with veneration on those religious teachers of the past who were striving to bring man's mind into harmony with the ruling spirit of the universe

To abandon the supernatural and question man-made dogma is natural in the light of that cleaner vision which is the product of long years of effort to understand “the author of nature” We are but continuing what was begun long ago, and in all humility, we recognize that posterity will amplify and correct our still imperfect philosophy.

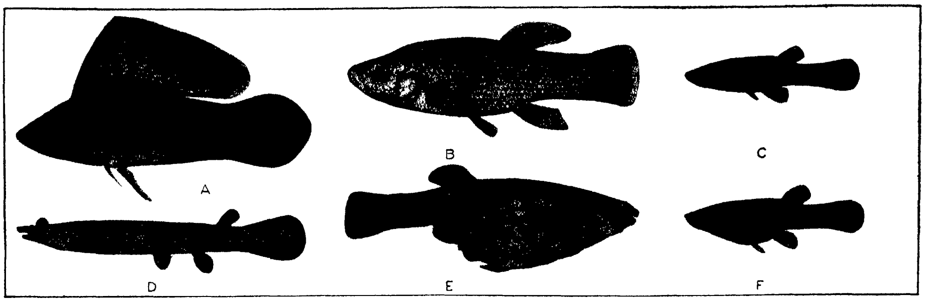
Boys Are Potential Scientists

Perhaps we may now, a little more acceptably, ask again how we may produce more scientific workers? How may we raise up a nation of people genuinely interested in natural phenomena, and especially in the processes of life? How may we attain that sort of scientific virtue which makes us see things as they really are and desire to solve human problems according to their real merits? How may we make scientific observation a social function, so that it makes good fellows, bound together by the kindness of a common interest? No doubt, the key to this problem is with the child. Wallace and Darwin and many others like them, refer to very early influences, very early developing aptitudes. It was certainly so in my case, and I can never be too grateful to those who gave me intelligent encouragement and sympathy instead of the too common disdain or hostility.

I cannot be too grateful to those who wrote and those who published cheap little books which were my inspiration and delight, Greene's “Insect,” Hunter's “Companion,” Coleman's “British Butterflies” and the translated “Insect World” of Figuier. I cannot forget the inspiration of the museums, especially the great British Museum, to contribute to which was one of my highest aspirations.

No matter how strong the inborn taste, it needs to be shared with others, or fostered by the sense that others have felt the same. The beginnings must be voluntary, part of the play activities of childhood, ripening into more systematic and purposeful efforts in later years. When there have been no such beginnings, it is difficult to stimulate the faculties which have already begun to atrophy, crowded out by others which have taken precedence. This may in a large part account for the disappointing sterility of the colleges, which are certainly not giving us the intellectual types we thought we had a right to expect.

Is it possible by taking thought to add one cubit to our scientific statue? Assuredly, it is only possible to develop innate faculties, but all observation indicates that these are too easily suppressed or crowded to the wall. We are not getting the results which our natures permit or would permit under favorable conditions Those favorable conditions can be created if we have the will, but we must first have the grace to understand.



SEVERAL TYPES OF FISH WHICH HAVE BEEN TRIED IN AN EFFORT TO EXTIRPATE THE MALARIA MOSQUITO

A: Mollienesia latipinna *Le Sueur, a beautiful little fish which was taken from Galveston to Honolulu. Being a vegetarian, it proved to be a failure* B Fundulus **grandis** ***Baird and Girard, a Gulf killifish,*** *also a failure as a mosquito devourer* C Gambusia patruelis *Baird and Girard, the female of the mosquito fish, which makes short work of* ***mosquito larvae; natural size*** D: Anableps *dowi, the four eyed fish, from Tehuantepec, Mexico, also a mosquito eater It swims on the surface, its eyes being divided by a cross* ***partition, the upper half for seeing in the air.*** E: Goodea luitpoldi *Steindachner, a Mexican killifish allied to* ***Gambusia*** *The eggs develop within the body, half natural size* F: ***Gambusia (gravid female)***

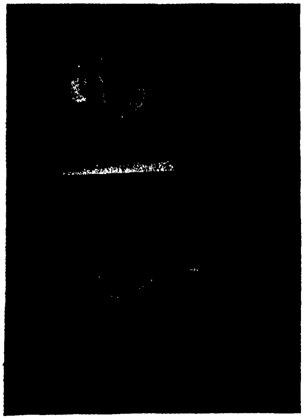
Malaria and the Mosquito Fish

A Plan to Exterminate Malaria by Means of a Fish that Eats Malaria-carrying Mosquitos

By Dr. David Starr Jordan

Chancellor Emeritus, Leland Stanford Jr. University

ONE of the most useful discoveries of the Nineteenth Century was that of the nature of malaria, with its kindred diseases, yellow fever, dengue and the like. It has been found that malaria is not a product of miasma as the accepted name of "bad air" would signify. Neither is it "catching" in the ordinary sense of propagation by contact. It is borne from one person to another by the bite of mosquitos. The big mosquitos of the north may offend by their abundance, their vociferous song and their vicious bite, but they do not carry disease. The dangerous ones are smaller, less insistent, and with a softer voice, but they are much more likely to be poisonous.



DR JORDAN IN HONOLULU, HAWAII

Planting the Japanese Ayu, by sinking a box of the eggs, with holes for the escape of the hatched fish

The cause of malaria of all sorts, ague, chills and fever, and of dengue, and yellow fever, is the presence in the blood of multitudes of minute, parasitic animals, which at intervals breed in prodigious numbers, with corresponding but varied discomfort. The biting of a man having malarial trouble, by a mosquito of a certain particular kind (known as Anopheles), transfers one or dozens of these creatures to its own body, causing it, no doubt, lamentable discomfort. Later the mosquito may bite another person "to take the taste out of his mouth." This next victim receives another bite and perhaps a third, thus passing the malady along through the agency of the mosquito's body.

The Problem Stated

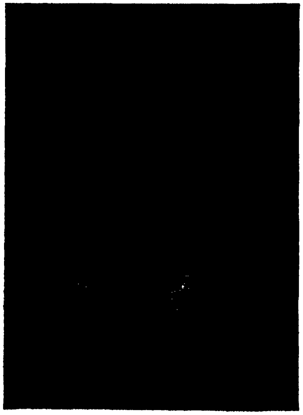
The problem of the cure of malaria is for the most part bound up in our skill in poisoning the malaria with the least damage to their human host. Thus far the most successful method has been the use of salts of quinine. This extract from "Peruvian Bark" from the Cinchona tree of South America, is fatal to all the malarial microbes with which it comes in contact. It is not a very wholesome drug as far as man is concerned. The main point is that it kills the microbes without killing him.

But prevention is always better than cure. The way to put an end to malaria ravages is to extirpate the mosquitos. In rainy regions this is hard to do, but the worst kind of mosquitos belong to the tropics or to regions just north of the Tropic of Cancer. They are often virulent in swamps, but apparently equally so in drier regions not connected with jungles. Thus certain districts in the Ukraine, in Macedonia, in Greece and in Southern Italy, have been historically notorious. The Campagna of Rome, and "Five Fingered Sparta" are classical examples of the undoing of populations by mosquitos. The "fading of the glory that was Greece" due primarily to her suicidal wars, was also in large part, the work of mosquitos. I know personally something of their havoc in Macedonia and I am told that in regions about the Black Sea the plague is still more virulent.

The work of our naval surgeons, Reed, Lazear and their associates, in the cleaning up of fever-stricken Havana, followed by work in Vera Cruz, Guayaquil and other poisoned ports, is a classic in medicine. To get rid of mosquitos is now one of the first elements in "preventive medicine" or sanitation.

How shall this be done? There are three lines of attack, to get rid of their breeding places; to cover these with oil, or to bring in an enemy which will devour their eggs and young.

As to the first, pools can often be drained or filled up with sand or rock. As to the second, all mosquitos lay their masses of eggs in quiet or stagnant



"DAVID STARR JORDAN AND THE 40 THIEVES"

Thus does the author caption this picture. Dr. Jordan's strongest interest is in ichthyology water, in which they hatch. A layer of petroleum over the water will smother their larva or "wigglers" and will also prevent the winged insect from ever escaping. But there are many bodies of water in which neither of these methods can be used. In such cases, the mosquito-eating fishes are the best resort. A good many kinds of little fishes will eat mosquito eggs or larvae when they find them convenient. Sticklebacks, young trout, some minnows, even gold fish do this to some extent. But what is needed is a kind of fish that makes mosquito killing its chief business, which enters on it with alacrity and which will not or cannot harm other more choice kinds of fish.

These desired traits are found in perfection in the "top minnows" or "Gambusinos" of the genus Gambusia. Of this genus there are numerous species in warmer parts of America. Most of them belong to coast streams of eastern Mexico and farther south. Two of them, very much alike, range through our South Atlantic and Gulf States One of these, *Gambusia patruelis*, is found from Alabama and Texas to Southern Illinois. Another, *Gambusia holbrooki*, extends from Georgia north to the lake of the Dismal Swamp, in Virginia. A third, *Gambusia affinis*, belongs to the Rio Grande region. In Cuba, such little fishes are called "Gambusinos" hence their scientific name, "Gambusia." When an angler returns without fish, the Cubans say, "he has been fishing for Gambusinos."

A Successful Attack

Old travelers may remember that Hawaii, twenty and more years ago was cursed by mosquitos. Large ones *(Culex)* brought from Alaska by whalers in their water tubs, in the days when Hawaii was their chosen winter resort, ruled the islands by day, and a smaller one, probably from California, was listened to at night.

Mark Twain, at the old Hawaiian Hotel felt this grievance, and in a characteristic way set out to remedy it. Everyone slept at night under a mosquito canopy and every night some of the smaller insects crept through the meshes. Mark waited one night until all the mosquitos came in through the netting and then slipped out and slept on the floor.

But even this shrewd device often failed. At last, in 1904, the City of Honolulu (knowing the present writer to be a fish sharp), sent a credit of about fifteen hundred dollars (of which about six hundred was used) asking me to discover and send to the islands a fish that would really eat mosquitos.

A California student will tackle any problem, and so I sent out Alvin Seale (then a senior at Stanford, now superintendent of the Steinhart Aquarium in San Francisco) He was instructed to go to Louisiana, and to enter the bayous to test out three species which might meet the demand Each of them ate mosquitos but in no case had their efficiency been tested. New Orleans was then once more in the throes of yellow fever, so Seale moved across to Galveston and filled his milk cans with the chosen fishes. These creatures are all very hardy, and very few died on the voyage to Hawaii.

ÆDES SQUAMIGER
A harmless salt marsh mosquito. No mosquito that rests horizontally when it bites is a bearer of malaria

Arrived at Honolulu, each species was tested out in aquarium tanks in drug-store windows, each one filled with stagnant water, stocked with mosquito eggs. The largest fishes, *Fundulus grandis* showed little interest in the matter. They were poured into a pool and have not been noticed since. The next species *(Mollienesia latipinna)*, did a little better This is a very handsome little fish, with high fins and varied colors. But it is mainly a vegetable feeder, preferring "frog spittle" *(Confervae)* to insects, and seemed not little likely to satisfy. It now abounds in the waters about Honolulu, where it is valued as an aquarium-fish and is largely caught for bait

The third set of fishes *(Gambusia patruelis)*, rose at once to the occasion, and almost instantly cleared the aquarium of mosquito eggs and wigglers It is, no doubt, the greatest mosquito killer in existence. It has lived and multiplied in all available waters in Hawaii. It swarms in irrigation ditches and in pools in the rice fields It is so abundant that it is now gathered up in nets, baked and crushed as food for the fishes in the Waikiki Aquarium It does not migrate to the sea, and it does not attack other fishes.

In a recent visit of two months in Honolulu, I saw but six mosquitos, all of them small, and no doubt hatched in rain pools or tin pans or other small bodies of water, which the most assiduous fish cannot reach

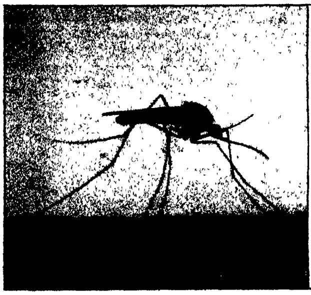
From Honolulu the fish has been taken to Formosa, from which island specimens have been sent back to me It has gone on to Luzon with equal success, and no doubt to Southern Japan and China, and ultimately I hope, to all around the world. A native of warm regions, it is not certain how much cold it will stand Last winter, in California, the temperature dropped two or three times to about 30 degrees, but none of the fish seemed to suffer. In October they slip to the bottom, in mud and weeds to keep their little toes warm, but the younger members of the flock may be seen near the surface in any of the so-called winter weather of Central or Southern California. Whether they would live if the surface were frozen over we do not yet know They feed on flies and mosquitos by choice, rejecting wasps, beetles, butterflies or larger insects I have seen them leap out of the water to seize an incautious fly alighting on the edge of their pond.

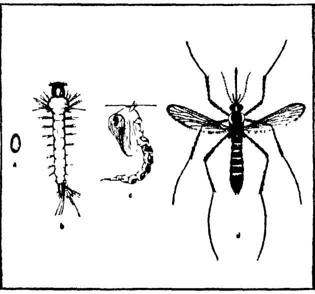
These fishes are light brown in color, without conspicuous markings anywhere The female is two and one-half inches long, the male rarely more than an inch About ten females are born, to one male. The eggs are hatched in the body of the female, six to ten in one brood, there being four or five broods between March and September The young when born are transparent, with big black eyes, and are about a fifth of an inch in length.

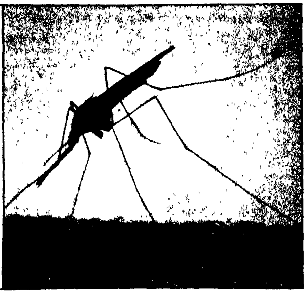
Little Fish, Big Appetite

The *Gambusia* is extremely hardy. It will thrive in any still water, not too cold It flourishes in the gutters of Vera Cruz and other dirty cities in which a ditch along the street takes the place of the sewer. So far as I know there is no first-class, mosquito-eating fish in any waters of Europe, certainly none where it is most needed—about the Mediterranean and Black Sea The writer has urged on the Red Cross and other good people charged with the sanitation of these districts to introduce and try out the *Gambusia*. It would be easy to transfer a few tanks of them to Greece or Sicily or the Crimea. An artificial pond of two or three rods in diameter, stocked with water plants or even frog spittle, would in a very short time meet any demand

With this little fish active in the pools and swamps of Southern Europe, thousands of lives could be saved, and millions of others rescued from perennial misery


CULISITA INCIDENS
The body of this common mosquito is horizontal when biting, giving assurance that it will not transmit fever


ÆDES AEGYPTI
This is the well known yellow fever mosquito which has caused the death of many millions of human beings


ANOPHELES MACULIPENNIS
This is the American malaria mosquito It may be easily distinguished because it stands on its head when it bites

Acoustical Research in Auditoriums

By Making a Scientific Study of Rooms Having Bad Acoustics It Is Often Possible to Eliminate Echos

By H. H. Sheldon, Ph.D.

Chairman of the Department of Physics, Washington Square College, New York University

STICK your head into an empty barrel and talk in a loud voice. How much of what you say do you suppose will be understood by an auditor near by? Stand on the platform of an empty auditorium or concert hall and talk to a single auditor in the rear, on some subject unfamiliar to him. How many of your words will he recognize? In some halls he will hear all of them, but generally this will not be the case if the hall is large enough to seat more than a few hundred people.

FINDING THE TIME OF REVERBERATION

FIGURE 1. *These curves show time in seconds against the cube root of the volume in cubic feet. From them the proper time of reverberation can be found. Upper, "no audience", center, one-third audience, lower, full house*

Why do we build our auditoriums like empty barrels, to pick up, reverberate, re-echo, and distort the sounds produced in them? Because few of us take the trouble to learn the simple fundamental principles governing the construction of halls of correct acoustical properties, or the methods of correcting those already constructed.

If one could say, "mix two cups of sugar with six of butter, to this add vinegar to taste, stir well before using and bake in a slow oven," that would simplify the whole matter and halls would be well designed from then on. Each auditorium, however, is a new research problem and must be treated as such. Now a research problem requires three things of the individual undertaking it—first—a certain amount of brains (which most of us have); second—the ability to think for oneself (which few people care to trouble themselves to do); and third—ingenuity, which I believe to be an inherited trait. Those who have these qualifications are now going to be let in on something. The trouble with the barrel to which reference was just made was "reverberation." Get back upon the stage again—shout, drop a timber, or something of that sort, and you will hear reverberation for one or two seconds, even in a small hall of good acoustical properties, and maybe for five seconds or more in a large hall of poor quality. A certain amount of this reverberation is necessary. Otherwise the hall would sound "dead" and when an audience was present the sound would not "build up", near the back of the hall hearing would be poor.

Just how much reverberation is desirable has been determined by extensive research, and is shown by Figures 1 and 2 which are taken from "Acoustics of Buildings" by F. R. Watson and are deduced from the mathematical theory of reverberation. More reverberation is allowable in halls used for music than in those used for speaking. The carrying of one note over into the next is somewhat desirable, but the carrying of one syllable over into the next is confusing. It is seen from the curves that the size of the hall is important when reverberation is being considered.

The Danger of Echoes

Now the question comes, "Suppose we wish to build a new hall, can we determine beforehand the amount of reverberation which it will have? After the hall is built, it will do us little good to discover that sounds persist longer than they should. Can we, however, correct it even then?"

Thanks to the excellent work of the late Prof. Wallace C. Sabine the answer to both questions is yes. Prof. Sabine developed a formula giving the time of reverberation most suitable for any hall. This formula was $t = \frac{.05\,V}{a}$, where t is the time in seconds, V is the volume of the hall and "a" is the absorption coefficient. The latter differs for different materials. The factor "a" can be determined from the table given in Figure 3 (from "Acoustics of Buildings"). The number of square feet of each kind of material in the building is taken separately, is multiplied by its factor and the results for each are added together, giving the final value of "a."

The following example is taken from the book already referred to. The hall to be used for music had a volume of 231,000 cubic feet. Taking the cube-root of this number, 61.4, and referring to Figure 2 it is seen that 2.4 seconds is, on the average, the proper time for reverberation to persist in this case. According to this, then, the value for "a" should be 4812 units (Figure 4). Computed from Figure 3 it is actually as follows:

CURVES FOR SPEAKING AND MUSIC

FIGURE 2. *This gives the conditions for best results when the hall is to be used for speaking as well as for music. Less reverberation is allowable in halls that are used for speaking than in those that are used only for music*

Plaster — 23,300 sq ft at 025 = 582 units
Wood — 15,448 sq ft at 061 = 942 "
Vents — 455 sq ft at 1 00 = 455 "
Glass — 616 sq ft. at .025 = 15 "
Upholstered seats — 1 042 sq ft at 1 5 = 1563 "
3557 "
Audience — 350 at (4.7 — seat at 1 5 = 3 2) = 1120 "
4677 "
Audience 1.042 at (4.7 — 3 2) = 3340 "
(3340 + 3557) = 6897 "

The time of reverberation for no audience was = t = .05 × 231000 — 3557 = 3.25 seconds; for 1/3 audience t = .05 × 231000 — 4677 = 2.47 seconds, and for full audience t = .05 × 231000 — 6897 = 1.67 seconds. Such a hall would be very

Sound Absorption Coefficients

Akoustolith (artificial stone)	per square foot	36
Brick wall, 18 in thick	" " "	032
Brick wall, painted	" " "	017
Brick, set in Portland Cement	" " "	025
Carpets, unlined	" " "	15
Carpets, lined	" " "	20
Carpets, heavy with lining	" " "	25
Carpet rugs	" " "	20
Celotex, ½ in thick	" " "	31
Cheesecloth	" " "	019
Cocoa matting, lined	" " "	17
Concrete	" " "	015
Cork tile	" " "	03
Cretonne cloth	" " "	15
Curtains, chenille	" " "	23
Curtains, in heavy folds	" " "	5 to 1.0
Flax, 1 in thick, with unpainted membrane	" " "	.55
Glass, single thickness	" " "	027
Hairfelt, 1 in thick, with unpainted membrane	per square foot	.55
Hairfelt, 1 in thick, with painted membrane	" " "	25 to 45
Hairfelt, 2 in thick, with unpainted membrane	" " "	.70
Hairfelt, 2 in thick, with painted membrane	" " "	.40 to 60
Insulite, ½ in thick	" " "	31
Linoleum	" " "	03
Marble	" " "	01
Oil paintings including frames	" " "	28
Open window	" " "	1 00
Oriental rugs extra heavy	" " "	29
Plaster on wood lath	" " "	034
Plaster on wire lath	" " "	033
Plaster on tile	" " "	.025
Stage opening, depending on stage furnishing	" " "	.25 to 40
Varnished wood	per square foot	.03
Ventilators (50 percent open space)	" " "	.50
Wood sheathing	" " "	.061
Wood, varnished	" " "	.03
Individual Objects		
Audience	per person	4.7
Church pews	per seat	.2
House plants, per cu ft	" "	.0031
Seats, upholstered, depending on material and lining	" "	1.0 to 2.5
Seat cushions, cotton covered with corduroy	" "	2.16
Seat cushions, hair covered with light damask and canvas.	" "	2.27
Settees, upholstered in hair and leather, seat and back	" "	3.
Wood seats, for auditoriums	" "	.100

FIGURE 3: *Each of the substances commonly used in halls has its own coefficient of sound absorption. Those given in this table relate to the formula given in the text*

COMPUTING THE COEFFICIENT OF ABSORPTION

Figure 4: *How Sabine's formula may be used to compute the most desirable value for the coefficient of absorption*

satisfactory so far as reverberation is concerned.

If the hall is still to be built, the materials can all be determined beforehand. If it is already built it can be corrected by adding panels of suitable material to the walls in order to make the necessary change in reverberation, or by using false walls of lattice work out from the main wall.

If we stand at some distance from a smooth cliff or a relatively flat-surfaced building and shout "echo," then, as the poets say, "Echo answers 'Echo.'" Actually, as youngsters we were more likely to shout "You old fool," and so on. But as investigators our interest is in the distance at which we must stand from the wall and in what happens at the wall. Ground glass will not reflect a beam of light because it has roughnesses comparable in size to the wavelength of the light, while a smooth mirror will reflect such a beam. So with the cliff and the sound wave which strikes it. (Figure 5)

Second, an echo is not distinguishable as such if it strikes the ear less than one-sixteenth of a second after the original sound Since this is a rather rough measurement, and allowing for difference in individuals, it means that sound can travel about 75 feet in this interval of time. Therefore, in order to hear an echo one must stand not less than 35 feet from the wall, so that the distance the sound travels to the wall and back will be 70 feet or more.

Therefore, in an auditorium with a speaker on the platform we shall not hear an echo unless the sound reaches us by two paths which differ in length by 75 feet or more. This rules out small auditoriums, differences in path as large as this are there out of the question In larger auditoriums it may happen quite readily, due to reflections from the walls and ceilings. This is especially true where smooth, curved surfaces are used.

The reflection of sound can be illustrated by means of two parabolic reflectors (Figure 6). By using these the ticking of a watch can be distinctly heard over considerable distances.

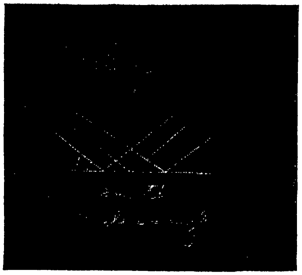
In a rectangular hall of any size, echoes are extremely unlikely because the reflected sound shows no tendency toward concentration. Instead, it spreads out, giving a reverberation. It is only when curves, of which architects are so fond, are employed that real danger of echoes exists. A circular amphitheatre, with domed roof, smooth plastered (a style not uncommon), is wonderful in respect to its echoing possibilities. Figure 7 shows cross sections with possible echo regions. For the sake of simplicity, these illustrations have been only slightly more exaggerated than some that have been observed.

In correcting an auditorium for echoes it is necessary to find the places in the hall where they are troublesome. This can be done by taking up each curved surface separately and applying the well-known law of reflection—that a reflected ray makes the same angle with the surface that the incident ray makes. If you think of a line as being drawn from the speaker to a spot on the wall, then the observer should be so stationed that a line from him to the same spot slants away from the wall by the same angle as that from the speaker to the wall. If the distance from the speaker to the spot and to the observer is greater than the direct route, that is, speaker to observer, by more than 75 feet, and if the wall is curved or arched, an echo is likely to be heard more or less distinctly, depending upon the curvature and material of the wall.

More Research Is Needed

One exact way of testing for echoes is to place a watch at the focus of a concave reflector, for example, in place of the bulb of a spot-light having the glass removed, or at the focus of the reflector of an electric heater. Place this on the stage in the position of the speaker and turn it toward the suspected portion of the wall. Locate your position according to the law of reflection. If an echo exists, the watch can be heard clearly, if the hall is quiet.

Another and a more satisfactory way is to place at the focus of such a reflector a carbon arc, such as is used in an ordinary stereopticon or projection lantern, and to light it with alternating current instead of direct The reflector is turned so that the light strikes a mirror held flat on the suspected wall and the echo of the hum produced by the alternating current arc is sought at the place to which the mirror reflects the light. This eliminates most of the guess work. The same procedure may be used by reflecting the light from a spot-light and finding where it goes, then replacing the bulb with the watch as before.



WHY SMOOTH SURFACES MAKE ECHOES

Figure 5 *Rough surfaces reflect sound in all directions From smooth ones it follows the law shown in the figure*

When it has been established that any portion of wall surface is responsible for echoes, the correction lies in covering it with sound absorbing material or in roughening it, if possible, so as to break up the echoes. For example, it may be coffered or latticed to harmonize with the architectural scheme.

The question of the proper size for a hall is one upon which little research has been done Obviously, a military band would not sound well in a drawing room, nor could a single speaker be properly heard in a stadium But there are finer shades of distinction than this to be drawn Fortunately the ear helps out in this regard, for actually a dozen instruments do not sound twelve times as loud as one, but only two or three times as loud Thus considerable latitude is allowable in any hall

There is obviously some best size, however, for an auditorium to accommodate an orchestra of any particular number of pieces This size should be just as possible to determine as is the best time of reverberation, and would depend upon the number of brasses, strings, wood-winds present.

A considerable amount of useful research remains to be done in this study of acoustics, and the author hopes that those who are interested in obtaining further information for its own sake, or for application in designing or correcting halls in which they are interested, will feel free to communicate with him Of particular interest will be inquiries from those who wish to make a systematic study of this subject with a view to becoming specialists, and from those who wish to aid in research to add to the meagre knowledge which we now have of it.

Photographs by Brown Bros. especially for the Scientific American

CURVED WALLS AND CEILINGS ARE OFTEN TO BLAME FOR BAD ACOUSTICS

Figure 6: *The ticking of a watch can be heard over long distances by using parabolic reflectors. The path of the reflected sound waves is shown on the blackboard*

WHAT OFTEN HAPPENS WHEN THE WALLS ARE CURVED

Figure 7: *Auditoriums are frequently built with cross sections, vertical and horizontal, similar to those shown here The distinctive results which may follow are made clear by the sketch*

Our Point of View

The True Pioneers of Industry

MOST earnestly do we commend to the attention of the public of America, and particularly of those who control the vast industrial interests of the country, the protest of Secretary Hoover against our failure to make adequate provision for research in the realms of pure science.

Without its Lewis and Clark, its Daniel Boones, its Kit Carsons, its covered wagons and the undaunted hearts of the men that manned them, the America that we know today would have remained a shadowy dream of the comfortably housed and stay-at-home visionary.

The man with the test tube and the microscope is the pioneer of the vast, unexplored fields of pure science. When he stops, progress stops All the wealth of all the oil kings, sugar barons, railroad magnates and multitudinous millionaires of our boasted civilization could not buy its way into those unknown lands unless the pure science pioneer blazed the way.

In the past, thanks to our richly endowed universities, industry through these institutions has been well supplied with modern representatives of the great prototype, Sir Isaac Newton. But the captain of industry has gathered in these gentlemen and set them to the special task of applied science research in the one limited field covered by his particular industry; so that, today, for one investigator devoted to the detached field of pure science, there are ten at work in the special and limited fields of applied science in steel, textiles, chemical products, oil, and so forth.

Never was a more timely warning uttered than that of Mr. Hoover when, in characteristically forceful phrases, he called the nation's attention to our steadily-diminishing efforts in pure science investigation We recently referred, and we refer again, to the statement of Dr Robert A. Millikan, when he said, "Subtract the idea that was born with the formulation of Newton's law of motion from modern civilization, and that civilization collapses like a house of cards, and mankind reverts at once to the mode of life existing in ancient times."

It is the aim of Secretary Hoover and the National Academy of Science which will administer the fund, to secure the sum of $20,000,000—the interest on which will be devoted entirely to pure science research. Three million dollars of this sum has already been obtained, and if the business interests of the country realize that we are lagging behind the rest of the world in this field of effort, and that our industrial supremacy, because of this neglect, is being seriously threatened, there will be no difficulty in securing the full sum, great though it may seem to be

An Impossible Canal

"POLITICS makes strange bedfellows"; as witness the present scramble of our politicians to tuck themselves in under the blankets alongside the proposed $600,000,000 ship canal from the Great Lakes to New York.

The civil engineers of the country, who have an inborn love for solid facts, straight thinking and truthful statement, have long ago decided that the idea of cutting a deep sea or ship canal through the heart of New York state, judged from the standpoint of economics, is an impossible phantasy. Judged as a mere feat of construction, the thing can be done, although when the big ditch was dug, it would prove to be a serious question as to where the water could be obtained to maintain the canal throughout its upper levels.

Any qualified and unbiased economist will tell you that the prospects of obtaining adequate returns on a canal through New York state, which will be eight times as long as the Panama Canal and will cost 50 percent more than that most costly undertaking, is extremely remote. Furthermore, 30 feet is the minimum useful depth for any ship canal. The Suez Canal has been deepened to 30 and 35 feet, and our own Panama Canal carries 40 feet throughout and 45 feet as a maximum. By the time any canal, whether down the St. Lawrence or across New York state is completed, there will be an insistent call for 30 feet as the minimum serviceable depth, if sea-going ships are to sail from deep water to the various ports on the Great Lakes. By that time, means will have been found permanently to raise the lake levels, and the leading lake seaports will have deepened their channels and waterways to 30 feet.

These Great Lake improvements are as certain as the daily rising of the sun, and if politicians succeed in burdening the federal government with this $600,000,000 venture, the country will find itself carrying the load of a great engineering work that is altogether inadequate for its purpose. The present barge canal is a white elephant, and changing the barge canal into the proposed ship canal would be merely to exchange one white elephant for a larger one.

Give "Old Ironsides" a Suit of Sails

It is gratifying to learn that the response of the school children of the country to the appeal for funds to rebuild *Old Ironsides* has been so generous that the required fund of $500,000 will undoubtedly be raised. So great is the interest in this famous ship, that the fund could have been secured quite readily from people of means throughout the nation, but Admiral Andrews, the Commandant at the Boston Navy Yard, and those associated with him in this enterprise, wished to make the reconstruction of this historic ship the means of awakening deep interest among the school children of the country in the glorious early history of the United States Navy.

We venture to make the suggestion that when this splendid frigate is once more afloat in all the beauty and majesty of her towering masts and huge spars, it would be well worth while to fit her out with a complete suit of sails and use the vessel for training either our midshipmen or our embryo naval reserve officers in seamanship. Let the renovated *Constitution* be maintained as a regular commissioned unit of our navy, and let her cruise in the summer season from port to port, and at times sail across the western ocean to show Old Glory in the foreign ports, where she flew her flag when she was making history and winning respect for the youthful republic of the western world.

It is a favorite trick of the politicians, when they are trying to boost some scheme which they know cannot stand on its own merits, to drape it with the American flag and cry aloud from the housetops that the thing must be done at the particular place and in the particular way proposed, because, it will be an "all-American" venture and is "absolutely necessary for the purpose of national defense." There are occasions when this appeal to the patriotic instincts of the people is perfectly proper and eminently helpful, but the present outburst of propaganda for the construction of the ship canal is not one of these.

Lakehurst Station Will Be Maintained

IN our issue of March, 1926, on page 156, in commenting upon the House Naval Bill, we stated that the discussion of the bill had revealed a sharp division of opinion among the ranking officers of the navy, particularly as to the future policy in regard to the construction of dirigibles. We stated that Secretary Wilbur and Rear-Admiral Jones were opposed to the construction of a new dirigible to take the place of the *Shenandoah;* that they were in favor of closing down the activities of the Naval Station at Lakehurst, New Jersey, and recommended that the sum appropriated for the maintenance of that station be reduced from $1,880,000 to $130,000.

We are now in receipt of a letter from the Navy Department which states it is evident that through some error, the writer of this article has misunderstood the attitude of Secretary Wilbur and Rear-Admiral Jones, and that it is hoped that we shall be able to correct this error in the near future. We hasten to make this correction, and it is as gratifying to us as it will be to all who are interested in lighter-than-air navigation, to learn that both of these gentlemen are in favor of maintaining the Lakehurst Station in operation, and favor, moreover, the construction of a dirigible, over twice the size of the *Shenandoah*, to take the place of that ill-fated ship

We are the more glad of the opportunity to make this correction because we realize, as perhaps the Navy Department does not, how widespread was the impression that Secretary Wilbur and his ranking officers were so discouraged by the smash-up of the *Shenandoah* that they were in favor of abandoning further lighter-than-air aeronautical work. This was the universal impression in our office, and so far as the writer's experience goes, it was the impression of the general public

We are now satisfied that this misunderstanding arose from an over-emphasis by the public press of that clause of the report of the General Board which deprecated appropriations for lighter-than-air work, if such appropriations would involve the sacrifice of any of the surface-ship programme now in hand. We think the Navy Department is fully justified in its desire not to sacrifice surface ships of a well-approved type in favor of the relatively experimental ships of the air.

From the printed record of the hearings before the House Naval Committee, we quote the following from the Secretary's testimony which can be taken as settling definitely the Secretary's attitude on this important question: "We are not willing to abandon the work of the *Los Angeles*, but we recommend that Congress make the necessary appropriation for the maintenance of the *Los Angeles*, and Lakehurst as incidental to the maintenance of the *Los Angeles*."

MECHANICAL MATHEMATICS
Worked out by most ingenious instruments, furnish the complicated calculations necessary in modern anti-aircraft firing

Is Anti-aircraft Artillery Overtaking the Airplane?

An Answer to Those Who Fear the Danger of Invasion from the Air

By Colonel H. E. Cloke
Coast Artillery Corps, United States Army

CONSIDERABLE thunder has recently been in evidence on the question of national security against invasion from the air, so it is well that the public be acquainted with the exact facts of the case as they exist today.

There is a general belief among people at large that anti-aircraft guns fire at airplanes in the same manner as a hunter does with a shotgun when shooting ducks. This is not literally true, although in a certain sense the principle of "leading" ahead of the duck or plane is the same. The anti-aircraft gunner, however, does not "guess" on the "lead," but works out the amount mathematically.

Anti-aircraft artillery, which is now a branch of our Coast Artillery Corps, was first used in the World War, although two pilot mounts had been constructed by the French prior to 1914. No fire control whatever was in use.

The first guns used against airplanes were French 75 mm's. These were placed in gun pits or on platforms with their trails or wheels so arranged that the guns could be given greater elevation than is ordinarily possible on level ground. Eventually, a type was especially designed for high-angle fire. The methods of firing it were somewhat similar to the usual field artillery methods for land fire. It was found, however, that these methods were not applicable to the anti-aircraft gun problem, so new schemes of fire control and the design of automatic machines and apparatus for obtaining the basic elements of firing data had to be evolved. Eventually, a method of "predicting" a future position of the target or plane was conceived, such that when the guns had their sights set for this "predicted position" and were fired, the target and the projectiles met—theoretically.

This system of fire control has been worked out by experience in war as well as in tests, and in thousands of trials at our proving grounds. After trying all the various schemes presented or conceived, our country has gradually accepted the "angular travel method" as the best system so far designed. This system as well as the "linear speed method" makes the altitude of the target the basic element. It is dependent upon three assumptions. These assumptions are that the plane will travel in a straight line, at a constant speed and uniform altitude. It would, of course, be best to avoid any assumptions, but with a target such as an airplane, the problem is entirely different from that of a ship at sea. These three assumptions are to hold only during the period of time included in the time it takes to load the gun and the time of flight of the projectile.

"Predicted Position" Based on Mathematics

The loading or "dead time" is taken as eight seconds. This includes determining the fuse range. The time of flight varies with the altitude or height of the plane above the ground and the horizontal distance it is from the gun. With our present 1918-model, three-inch gun, it is almost nine seconds at 12,000 feet when directly overheard. At 7,000 yards range for the same height (12,000 feet) it is about 24 seconds.

If this total time (dead time and time of flight) be large, the plane can change any one of the above assumptions and avoid being hit, but if this time be reduced to a few seconds, the situation for the aviator becomes decidedly dangerous, especially if he be a heavy bomber without power to change these salient factors quickly Then again, the first burst of shells is the one which really "tells the story," for, it is understood that a squadron of heavy bombing planes (and these are the principal type with which we are primarily concerned) flies in formation as do ships at sea, with these three factors of speed, direction and height practically constant.

Our Ordnance Department has already produced an automatic 37-mm gun with a high muzzle velocity (3,000 foot-seconds) which gives a flat trajectory or almost straight line path of projectile and a very short time of flight Its maximum range is about 14,000 feet This gun fires a shell weighing 1¼ pounds to a height of 11,000 feet, and has a horizontal range of almost 8,000 yards. Its rate is 120 shots per minute The maximum ceiling expected from the latest types of bombers is about 15,000 feet Also, a tracer has been successfully developed which has powder composition at the base of the shell and burns with a bright light while the projectile is in the air, as does a skyrocket. This permits an observer to see each bullet or projectile as a skyrocket effect throughout its entire flight In addition, a fuse has been produced which is supersensitive and at the same time safe to handle. *It will explode the shell on contact with airplane fabric.* Furthermore, we are developing an automatic appa-

WIND AND PARALLAX COMPUTER

This instrument determines the deflections due to wind. These values are set on the data computer

ratus which will reduce the "dead time." We are striving to reduce the "dead time" and the time of flight and to increase the initial velocity of the gun.

This "predicted position" of the target is based upon good sound mathematics and is computed to the nicest degree of accuracy. To explain this clearly, let us illustrate the case of any cannon, gun, rifle, or shotgun. To shoot a running deer, we must aim our rifle *ahead* of the deer and at the distance *to* the deer. Or, in order to hit a "predicted" position of the deer as determined by experience or the hunter's trained eye, the sight must be set for the range and the rifle *lead*.

The heavy cannoneer does the same thing as a deer hunter, only he does it mathematically. He plots the position of his target on a map or plotting board, predicts a position ahead of the course of the ship or target, finds its range or distance in yards, and its azimuth (*direction from north and south line*) in degrees, then aims the gun at this range and at this angle. When the time of fire, or position, or target at its predicted position, less the time of flight, arrives (determined by a clock) the gun is fired and *theoretically* the ship or target must meet. This may be readily accomplished in heavy artillery fire directed at a ship at sea, for a ship moves on a two-dimensional surface. But how does the anti-aircraft gunner account for the third dimension called "altitude?"

Here is the crux of the whole situation. Altitude is the essential and the basic element in determining the necessary firing data which gives us the "predicted position" we are after. It is the altitude of the target which we must determine. A mechanical instrument called the altimeter, does this for us.

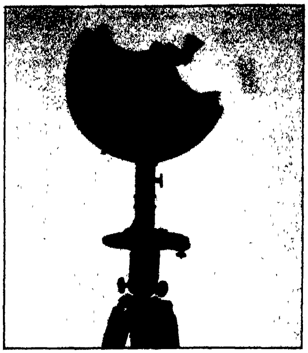
There are many different forms of altimeters in use today. Their construction is constantly changing toward simplicity and rapidity of operation. The one shown herewith is our present standard, although the tendency of the times is to design a self-contained instrument based either upon the coincidence, or the stereoscopic principle. Such an instrument would avoid the use of a base line, the use of two instruments, telephones, and so on, and would materially reduce the dead time.

The "angular travel" method is the standard present day fire control plan for determining the "predicted position" of aircraft as targets.

A Foolproof Mechanism

A sight is mounted on the gun carriage and is geared to it and to the gun. This appears to be a very complicated piece of mechanism for a soldier to manipulate, but it is so designed as to be positively fool proof. A rule or a method is all the sight operator or gunner need know. He may be entirely ignorant of all the mathematics upon which the instrument depends for its construction. His orders are to "set the sight for deflection" (the angular travel vertically and laterally during the dead time and time of flight of the projectile) and then to follow the target with the telescope on the sight. The gunners who operate the hand wheels on the gun carriage and gun have their instructions to turn these wheels so as to "follow the pointers" which are on the sight and which are continually moving as the gun pointer or man operating the sight follows the target with his telescope.

The men doing the loading and firing operate independently and fire whenever the gun is loaded, since with the automatic 37-mm. gun, the gun is constantly kept on the target.



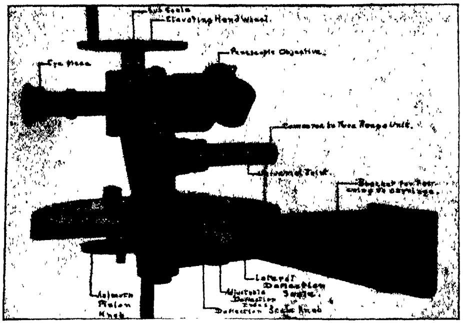
ALTIMETER ON TRIPOD

There are two altimeters used to determine the altitude, one at each end of a determined base line

But what data must this sight setter or gun pointer have before he sets this vertical deflection? Naturally, the angle at which his telescope points when the cross hairs are on the plane, gives him the angle of sight automatically. It should also be understood that the extra or "super elevation" over and above this sight angle or height angle of the plane automatically sets the gun's elevation at its correct amount by a very ingenious combination of levers, cams and gears. "Super elevation" is due to the trajectory itself. The angular height or angle of sight may be 52 degrees and the super elevation six degrees. The total quadrant elevation for the gun would therefore be 58 degrees, at which it must be elevated.

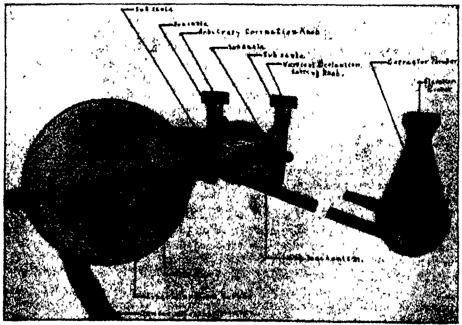
The essential elements of anti-aircraft fire then are: 1 Vertical deflection. 2 Lateral deflection. 3: Fuse range.

The instrument that has been designed and constructed for determining these elements is called "The Anti-Aircraft Data Computer Model 1917." It is mechanical in its construction and automatic in practically all of its functions. It determines mechanically these three elements of firing data.



ANTI AIRCRAFT SIGHT

This sight is on the left of the gun. It is connected to the elevation sight called the fuse range unit, on the right of the gun. It is operated as follows. (1) Gunner sets sight on target by operating the "Azimuth Pinion Knob" and the "Elevating Hand Wheel" (2) Another gunner sets the lateral deflection obtained from the data computer on the lateral deflection scale, by operating the knob (3) Another man keeps the two pointers on the lateral deflection scales in coincidence by turning the gears on the gun until these pointers meet. Thus is the gun kept constantly on the target at the "predicted direction"



THE FUSE RANGE DISC

This part of the sight is on the right of the gun. The elevation pointer is connected directly to the sight on the left. As the sight on the left elevates, this pointer moves. As the gun is elevated the corrector pointer moves with it. The vertical deflection and the fuse range are obtained from the data computer and set on the vertical deflection scale and the fuse range disc. The operation from then on is for the gunner at the elevating mechanism to keep the elevation pointer and the corrector pointer in coincidence. This keeps the gun constantly at the "predicted elevation" coincident with the "predicted direction"

The altitude of the target is the only data necessary to feed it, in order to produce these elements of fire. It is oriented in azimuth in a way similar to an ordinary transit. Thus, the gun is kept constantly set at the "predicted point." The ammunition detail loads and fires as fast as human hands permit, using the "fuse range," as given them by the "data computer," to set the fuses for the time of burst. Thus we have in a nut-shell the basic idea of anti-aircraft fire.

This "data computer" was originally designed by M. Rontin. The 1920 data computer produced in this country is electrical in principle and produces the total vertical and lateral deflections, including wind and parallax corrections.

The past records of anti-aircraft fire have been misquoted in the press of the country many times. In fact, the actual inside history of anti-aircraft fire has been misunderstood, and in some cases it has been considered so ineffective as to be useless.

The following tables are self-explanatory.

Year	Planes brought down	Shots fired per plane	Country	Rate
1916	60	11,000	French	...
1917	120	No record	French	
1918	220	7,500	French	
1918¼	No data	....	British	One plane for every 4,550 shots
1918⅓	No data	....	British	One plane for every 1,500 shots
1918½	No data	...	American	One plane for every 605 shots

Results for the entire war:

Nation	Planes dropped by aviation service, all fronts	Planes dropped by anti-aircraft fire	
Italy	540	129	
Germany .	6,554	1,520	
France	2,000	500	
America	Not obtainable	58	(17 with 75 mm guns) (41 with M G)
Total	9,095	2,207	

The American service was in action but a very short time toward the end.

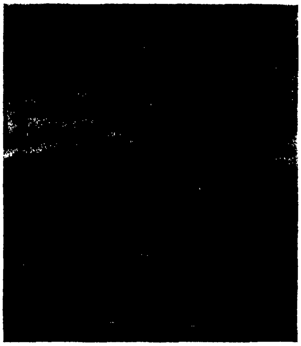
In Hawaii, 1925, target practice, an average of two hits per gun, per minute was made

Rapidly Gaining on the Airplane

At Fort Tilden, 1925, the following are the official results:

Number of shots fired	4,343
Number of hits....................	203
Hits per try, per minute..........	2.03

Or, one hit for each 22 shots fired; or one hit every 29 seconds.



THE STANDARD CORRECTOR, U. S. ARMY TYPE

This is one of the latest instruments for automatically determining the deflections It is mechanical in its operation and determines the lateral and vertical "lead" or deflection It has two telescopes, each operated by a gunner who keeps the cross wires of the telescopes constantly on the target

The guns and ammunition used in this test were far inferior to those which have recently been designed and tested.

The following table shows the summarized situation.

Year	Nation	Number of shots to drop a plane
1916	French	11,000
1918	French	7,500
1918	British	4,500
At close of war	British	1,500
1925	U. S Army	22

From these official reports, it is seen that the anti aircraft artillery is gaining rapidly on the airplane

It is safe to predict that the future anti-aircraft gun will be practically automatic, and it will have super sensitive fuses capable of exploding at a set time or on contact even with so thin a target as the wing of an airplane.

The trend of modern ordnance is also in the direction of higher velocities Increasing the velocity flattens the trajectory or path of the projectile and reduces the time of flight The main objective will be to hit on the first burst.

These two vital factors in anti-aircraft artillery *must* and will be accomplished, for, unless some entirely new and different and superior system of fire control is devised, the time of flight becomes the weakest spot in the system The dead time will in the future be reduced to but a second or two The time of flight will be *materially* reduced

In the light of last summer's tests and target practices held in various parts of our domains, especially at Fort Tilden and Honolulu, it is also believed that the future will develop an efficient method of correcting anti aircraft fire by "observation," as is now done in all other forms of artillery fire. In such a case, after laying the guns of an anti aircraft groupment on an oncoming squadron of high-powered bombing planes by our usual method of "angular travel," we could, after the first volley of shell bursts, "squirt the hose" on them as it were, the "predicting system" continuing to function, but as the hose pours forth its stream of fire, corrections based on observation would be applied from time to time The stream of projectiles is visible and the time of flight small, the fire incessant and the fuse explodes either on contact or by setting it for the predicted fuse range

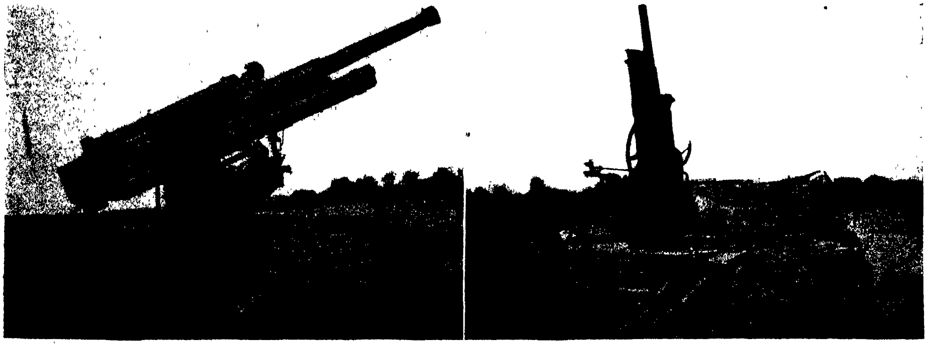
Where there is a will there is a way And it is the will of our watchdogs of national defense that this weapon be rendered so efficient that air bombers will be in as grave danger when attempting to invade our shore line as would an enemy fleet in attempting to subdue our coast forts

The Problem a Vital One

It is always the same old story When machine guns were invented, many people claimed war would be so frightful with this weapon that human beings could not withstand it Then when the submarine came, some claimed the navy should be all submarines and that all other classes of ships were useless. With every new invention of attack weapon there has always been developed a counter weapon to combat and destroy it. And in the case of the aerial attacker, we will adapt the destroyer, anti aircraft artillery.

The problem is a serious one, without doubt; it is a vitally important one to the defense and perhaps the very existence of our country, it is also a most difficult one, but that our country will be completely and entirely at the mercy of an enemy with superior air power is firmly disputed

Predicting upon the curve of the progress which has been made since the World War it is safe to state that a positive and highly efficient system of anti-aircraft defense will be realized during the coming year.



VARIOUS SIGHT MECHANISMS

Each operated independently, are clearly shown above. The resultant firing position is changed while the gun is being operated, and the moving target can thus be followed with accuracy

The Great Outer Planets

Jupiter and Saturn Have Hot Centers and Frigid Exteriors

By Henry Norris Russell, Ph.D.

Professor of Astronomy, Princeton University Research Associate of the Mt Wilson Observatory of the Carnegie Institution

AFTER months of absence, there is once more a planet to be seen in the evening skies. Since Venus passed out of sight in February, only Mercury has been visible in the early hours of the night, and then but for a few weeks and with difficulty Saturn, which has been a morning star since November, returns to opposition this month, and we shall have at least one planet in the evening sky for the rest of the year.

The great outer planets of our system have been studied telescopically ever since the instrument was invented; yet there remains more to be done in our time, and more is still to be accomplished. Some things, such as the determination of the distances of the planets and the calculation of their motions in their orbits, have been accomplished with such precision that little more remains to be done—until some improvement in our method of observation enables us to make our measurements with greater accuracy.

The distances and motions of the satellites, too, are very accurately known—though of course new and further satellites may at any time be discovered.

The diameters of the planets, though harder to measure with high percentage accuracy (owing to the "irradiation" or apparent enlargement of the image of a bright body on a dark sky) are pretty well known in the cases of Jupiter and Saturn—though those of Uranus and Neptune are uncertain by a much greater fraction of their values

But the physical conditions on the surfaces of these planets are not so easy to determine fully.

We know that the density of the planets as a whole is low. For Jupiter it is only one third greater than that of water, and for Saturn only a little more than half of this (71 percent of the density of water). We know, too, from the degree to which the centrifugal force due to the rotation flattens the planets at the poles, that the density must be much greater than the average at the center, and less near the surface (For a planet of nearly uniform density, the known rates of rotation would produce a much greater bulging at the equator.)

It is certain, therefore, that the outer parts of Jupiter and Saturn, for thousands of miles below their surfaces, must be of very low density—and therefore it seems sure that they are gaseous. Jeffreys has lately calculated that the known facts could be explained by assuming that Jupiter had a solid core—as dense as rock—58,000 miles in diameter, surrounded by an ocean (or a layer of ice) 11,000 miles deep, and this again by an atmosphere of very low density, and 4,000 miles in height. For Saturn the solid core would be 31,000 miles in diameter, the ocean 12,000 miles deep and the atmosphere extend to a height of 8,500 miles.

All that these figures show is that the density of the outer layers must be very low. An actual atmosphere thousands of miles deep would be under such pressure in the lower parts that it would be almost as dense as water, unless it was hot. So that it is probable that the inner parts of Jupiter and Saturn are at a high temperature.

The surfaces of both planets, however, are very cold. Measures of the heat which the planets send us show that almost all of it comes with the reflected sunlight, and very little from the surface itself, and that the temperature of the surface, in both cases, must be at least 120 degrees below zero, on the centigrade scale, and probably lower still. The conspicuous and rapidly changing markings on Jupiter's surface, which have long been recognized as of a cloudy nature, must therefore be due to clouds of some substance which condenses at a far lower temperature than water—and would boil furiously at a hundred degrees below zero.

Conditions We Cannot Duplicate

Above the clouds surface there is still a good deal of atmosphere, for the spectra of all four of the outer planets show bands in the orange and red, growing increasingly heavier from Jupiter to Neptune These bands have never been duplicated in the laboratory—perhaps because the thickness of the planets' atmospheres is much greater than any thickness of absorbing gas that has yet been experimentally tested, or perhaps, as Menzel has suggested, because the gaseous constituent which produces the absorption is stable only at very low temperatures and can exist in large quantities only at the very low temperatures of Uranus and Neptune.

Further evidence that there is a dense atmosphere above the cloud-surface is found in the fact that the disks of both Jupiter and Saturn are much less bright at the edge than at the center.

This is not conspicuous in an ordinary telescopic view, for the contrast between the edge of the planet and the dark sky outside exaggerates its brightness. But if one looks at Jupiter or Saturn in the twilight, and especially in the daytime, when they can just be seen through the blue foreground of a clear sky, the darkening at the limb of the planet is extremely conspicuous. The difference from the ordinary appearance on a dark sky is so striking that the observation can be especially recommended to amateurs familiar with the aspect at night.

Unfortunately, it is impracticable to find the planet by day without an equatorial telescope with divided circles; but the enthusiast who rises before dawn and watches Jupiter or Saturn when they are morning stars, in the increasing light, will be well repaid for his trouble.

Remarkably enough, practically no measures of the degree to which the brightness falls off at the edge of the disk have been published until very recently; but the matter has just been thoroughly discussed by Schonberg, who observed at Pulkowa and Dorpat, but has published at Helsingfors.

According to his measures, the brightness at the edge of Jupiter's disk is only one-eighth of that at the center. To account for this, it is necessary to assume that about 37 percent of the light is absorbed in passing through the planet's atmosphere. Near the edge of the apparent disk, where the path of the rays through its atmosphere is longer, the effect increases greatly.

Another conclusion of Schönberg's is that after allowance is made for the changing distances from the earth and sun, the brightness of Jupiter falls off about one percent for each degree of the "phase angle"—the angle which the line from Jupiter to the earth makes with that joining Jupiter and the sun.

A similar but much greater effect occurs in the case of the moon, and it can then be attributed with certainty to the fact that one satellite's surface is rough and full of objects, big and little, which cast shadows. When the earth is right between the moon and the sun (just enough out of the way to avoid an eclipse) each mountain or rock hides its own shadow; but if we are even a few degrees out of line, the shadows come into view on one side; and, even if they are too small to be seen separately on a great telescope, they darken the general effect of the surface and diminish the moon's light.

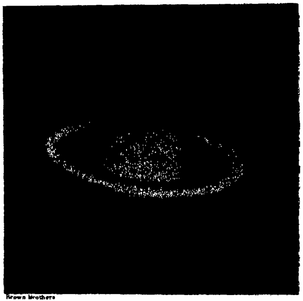
On Jupiter, the shadow-casting masses are presumably clouds, like the great cumuli, or "thunderheads" in our own sky. If about one-eighth of the surface was covered with such clouds and the rest with smooth clouds whose upper surface was free from shadow, the observed variation in brightness would be explained.

The rings of Saturn show a very pronounced phase effect—arising, as Seeliger showed years ago, from the fact that they are composed of separate particles, scattered in swarms so extensive that they look from a distance like a continuous sheet. Schönberg, after a careful study, concludes that within the apparently continuous rings, not one percent of the volume is occupied by solid particles, and that, all around these, is a cloud of fine dust—probably formed by collisions between the particles, which accounts for the high reflecting power of the ring.

Brown Brothers

JUPITER

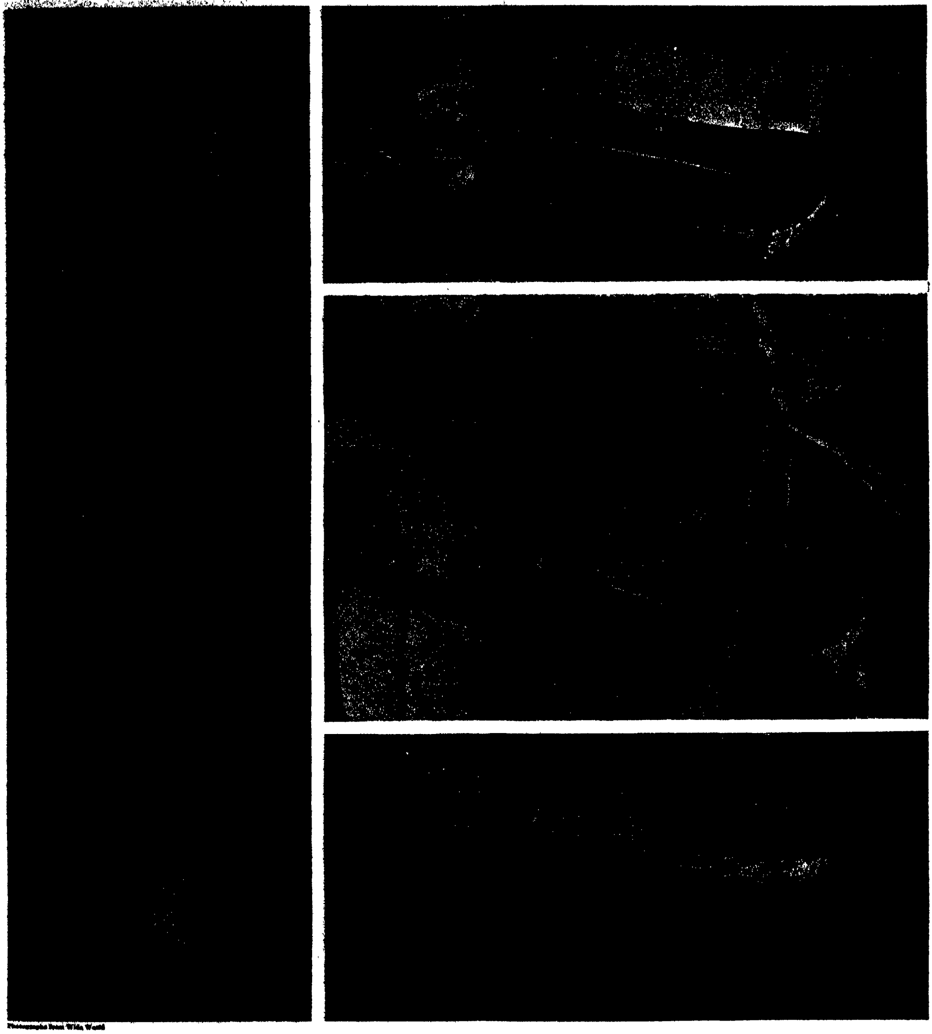
It has a thick mantle of extremely frigid clouds



Brown Brothers

SATURN

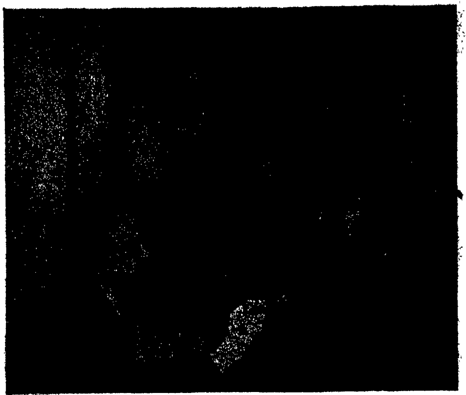
Its rings are made of swarms of particles and dust



Photographs from Wide World

Tut-Ankh-Amen's Golden Coffins, the Work of Ancient Egypt's Most Skilled Artisians

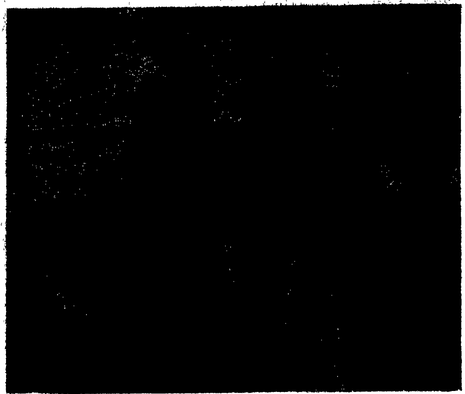
Within the burial chamber hewn from the solid rock, Tut-ankh-amen's mummy was protected by many enclosures of wood, stone and gold. First came three large wooden, box-like shrines, one within the other. These were removed two winters ago, revealing a great sarcophagus of yellow quartzite with granite lid. This lid was raised, but the work was temporarily stopped. Last winter the stone sarcophagus was found to contain three coffins, nested one within another. All three coffins are shown above, although the resemblance of the sculptured effigies on each renders their individual identification somewhat confusing. In the center picture the first or outside coffin of the three is being lowered away from the second, which fitted into it too closely to be lifted out. Both are of wood, covered with sheet gold. The lower picture shows the second coffin alone, its golden shell encrusted with polychrome glass. The top picture shows it with cover removed, revealing the third and final coffin, partly concealed by the funeral wreath and shroud. This third coffin, with shroud removed, is shown at the left of the page. It is over six feet in length and was beaten out of solid gold. It is embellished with turquoise, lapis lazuli and carnelian.



Kadel & Herbert

THE LUNGS OF A SUPER-BROADCASTER

By varying these flat condensers, the wavelength is sharpened to minimize interference. The two "pans" serve as verniers to the big condensers



Kadel & Herbert

THE SWITCH OF A MODERN BROADCASTER

So powerful is WJZ that the oil-immersed switches are automatically operated by a motor which is controlled from the main switchboard

Radio Whirlpools in the Ether

Modern Broadcasting Plants Charge the Air With Powerful Electric Streams

By Orrin E. Dunlap, Jr.

RADIO waves are often pictured by the analogy of a stone hurled into a pond causing ripples to emanate in all directions from the disturbance center. The larger the stone and the greater the force with which it strikes the water, the larger will be the waves and the farther they will travel. Here the analogy ends because the power of radio waves is not dependent upon their size. The length of the Hertzian waves has little to do with the distance they will cover. The amperes in the aerial circuit and the pressure in volts between the aerial and the ground are what count in broadcasting.

This etherial energy may be very strong despite the fact that it is invisible. So powerful were the electromagnetic impulses broadcast from MacMillan's ship in the arctic that the electric lights on board would glow by radio power although the lights were disconnected from the current supply. One member of the crew told how he placed an incandescent lamp on the pillow in his bunk and when the transmitter was in operation the bulb would emit light.

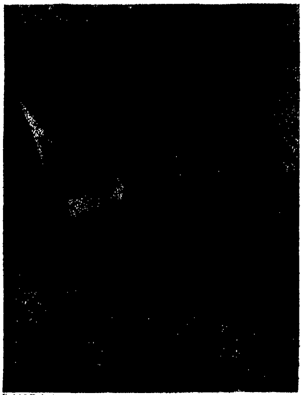
Microphone and Transmitter 35 Miles Apart

There are three spots in the ether of the United States whose turbulence may be pictured as waves created by a huge boulder. These etherial centers are: Bound Brook, New Jersey, Schenectady, New York, and Pittsburgh, Pennsylvania, where WJZ, WGY and KDKA respectively are located. Their impulses dwarf the waves radiated by the majority of stations into surface ripples.

Station WJZ was the last to join the super trio and for that reason the equipment may be considered the most modern, although the other broadcasters are constantly kept up-to-date.

Bound Brook, the home of WJZ's transmitter, is thirty-five miles from New York City, where the studio is located on the sixth floor of Aeolian Hall, 33 West Forty-second Street. There the entertainers actuate the microphone connected with the transmitter by a wire line which runs across Manhattan Island, through a submarine cable beneath the Hudson River and then overhead across the Jersey meadows to Bound Brook.

The new equipment on this New Jersey radio reservation astounds the average broadcast listener who visits the plant. The sturdy and heavily built apparatus, designed to handle thousands of volts and high amperage, reveals radio as an institution. It shows that broadcasting is no fad but an established public service destined for a great future both musically and otherwise, contrary to the prediction of Efrem Zimbalist that radio will die in two years.



Kadel & Herbert

THE HEART OF BROADCASTING

A few of the ten-kilowatt tubes used at station WJZ, Bound Brook. Note the large insulators and the water-cooling system. The water jackets at the top of the tubes are supplied with running water through the coils of rubber hose

The station resembles a power house more than it meets the average conception of a radiophone installation. It shows radio expanded from one or two small rooms on top of a building to a stucco structure one hundred feet long and seventy-five feet wide with other smaller houses and aerial masts scattered over several acres.

Broadcasting started in 1920 and the new WJZ is the result of accumulated knowledge of lessons gleaned from practical experience during the past six years. The engineers have brought every refinement and improvement into this station. For example, the transmitting room is enclosed in a copper shell to prevent radiation of harmonics, or incidental waves, which would interfere with broadcast auditors in reception of other programs.

Prepared for Emergencies

The slender steel masts or wooden poles which hold aloft the aerial wires of most stations are dwarfed by the two 300-foot towers spaced 700 feet apart on the WJZ plot. The four legs of each tower rest in large porcelain insulators so that the energy will not leak down the steel framework into the earth. The aerial is a cage arranged in "T" fashion, that is, the lead-in is taken off the center of the aerial proper, which is approximately 225 feet long.

The ground is a radiating network of heavy copper wire buried several feet in the earth.

The main transmitter is located on the ground floor of the largest building. The current-supply transformers and motor generators are in the basement. The power supply of 4,300 volts is furnished by a neighboring power house and transformers step down this current to 2,300 volts for conversion into direct current of approximately 10,000 volts. This is accomplished by vacuum-tube rectifiers supplemented by a bank of choke coils, whose duty is to aid in smoothing out the alternating current, to direct. The motor generators change the alternating current supplied by the transformers into 22 volts direct current for the purpose of lighting the filaments of the transmitting tubes.

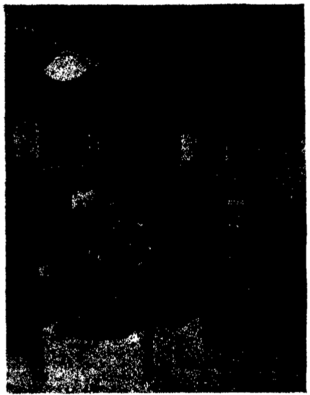
The station has more than one transmitter. The main station, tuned to the 455-meter channel, is rated at 50 kilowatts. There are three of these high-powered units. One is a duplicate of the main installation and it stands ready to be switched into the etherial circuit in case of emergency.

The third transmitter is also rated at 50 kilowatts output and it is tuned to radiate waves under 80 meters in length. This equipment is used to span long distances, because the shorter waves, projected high into the upper atmosphere, seem to have less difficulty in reaching across the seas. Furthermore, some contend that long distance broadcasting in the future will gradually shift to channels below 100 meters and in that event WJZ will be prepared. In the meantime, tests will be conducted to study the vagaries of the ether and determine the value of short waves. It is not expected, however, that there will be a sudden adoption of short waves by all stations, because there are many mysteries yet to be solved in connection with the lower wave bands.

Puzzles Created by Short Waves

The story is told how several amateurs gathered at a short-wave station in New York with plans to spend the night in the radio room in an effort to talk to as many different sections of the world as possible. Australia, New Zealand, France and England were easily reached and two-way communication established on the 40-meter wavelength. Then the operators tried to attract the attention of any short-wave amateur operator who might be listening in the Chicago or Denver districts, but all in vain. The nearest they could get to the United States was an army station in Hawaii.

The signals seemed to shoot up to the Heaviside surface in the upper regions of the sky, not to be reflected back to the earth until several thousand miles away. These trick performances of the short waves create puzzles which the engineers of the new station will strive to solve. It is pointed out that if the long-distance skip-effect cannot be overcome, the short waves will never be practical for broadcasting as it is carried on today by the 200 to 550-meter waves.


Kadel & Herbert

TRANSFORMER ROOM AT BOUND BROOK

The motor generators are in the basement of the main building. Current supplied by a power house is 4,300 volts. These transformers reduce it to 2,300 volts and the generators change the alternating to direct current for the tube filaments

Each transmitter at Bound Brook has six oscillators and twelve modulator tubes, each capable of handling 10 kilowatts of power. A tube of this size requires for operation at full capacity, as much power as would be used to light simultaneously every room in a dozen six-room houses The tubes are eighteen inches high and six inches in diameter. A water jacket, handling a flow of 3,300 gallons of water a minute, circulated under pressure, carries off the heat generated when the transmitter is in operation, as otherwise the tubes would melt. In order to obtain more than 10 kilowatts, several tubes are connected in parallel.

The power is so great that automatic switches immersed in oil and operated by electric motors, controlled from the main switchboard, are used to throw the knife blades of the switches into the desired position.

This transmitting set is a system of coils and condensers just like a receiving set, except that the broadcasting apparatus is built to handle heavy currents. By adjusting the inductance and capacity to a certain value, the transmitter is tuned to a definite wave, similar to the manner of tuning a receiving set. When the receiver's dials are revolved, the inductance and capacity of the circuit are adjusted so that the set is in resonance with a particular broadcaster.

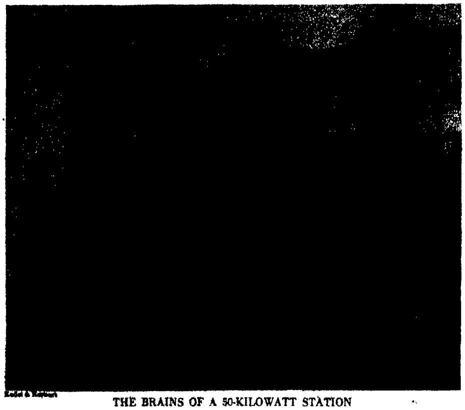
The coils of a sending station generally consist of heavy copper or brass ribbon. The condensers at WJZ are made of seven, thick, copper plates approximately six by two feet with the edges rounded. They are not housed by containers but are suspended from insulators. Air being a good dielectric, or insulating material, the plates are placed eight inches apart with nothing but air between them.

Waves Heard in Far-off Peru

The wires which connect the New York studio with the broadcasting apparatus terminate at a switchboard in the Bound Brook transmitting room. There the incoming speech and music forwarded from Manhattan in the form of electrical impulses are switched into the amplifiers and control unit. The amplifier consists of eight tubes, four rated at five watts and four at 50 watts.

One small but interesting structure on this New Jersey radio site is the home of a large variable condenser used for tuning the aerial circuit. The plates consist of large, copper sheets similar to those of the large fixed condensers mentioned above. This condenser is operated by a large electric motor

According to the engineers, WJZ seldom broadcasts on full power, but nevertheless, it is reported that the waves have been heard in Peru, in Germany, on the Pacific Coast and in every state in the Union. The station made its debut December 7, 1925, and the first two months of operation brought 65,000 letters to the studio reporting on the reception.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THE BRAINS OF A 50-KILOWATT STATION

The speech amplifier system and control panel of WJZ. Wires leading from the microphone in the New York studio terminate at this switchboard, 35 miles from the entertainer

Kadel & Herbert

A HUGE OSCILLATOR AT WJZ

Note the coils of rubber hose which carry water to the jackets of the vacuum tubes to keep them cool. By adjusting the large coil on top, the wavelength can be changed

Members of the American School of Prehistoric Research Inspecting a Dolmen Near Carnac, Brittany, France

Old Problems and New Methods in Prehistory

The Relations Between the Physical and Cultural Evolution of Ancient Man

By George Grant MacCurdy

Professor of Prehistoric Archaeology, and Curator of the Anthropological Collections at Peabody Museum, Yale University, Director American School of Prehistoric Research

OUR knowledge of fossil men is a late development, the significance of which could hardly have been realized without an apprenticeship in the study of fossil animals. In the days before vertebrate paleontology became a science, the bones of huge fossil animals, often uncovered by chance, were sometimes mistaken for those of a supposed prehistoric race of human giants.

The notion that there were giants in the olden days still crops out in spite of the interest now taken in the general field of the natural sciences. As an illustration, I venture to recall a page from my own experience. Some years ago I happened by chance to meet a young man in front of a large fossil leg bone (nearly six feet long and weighing 575 pounds), which had been mounted in the old building of Peabody Museum at Yale. The specimen was the thigh bone of a huge herbivorous dinosaur. The young man asked: "Is not that the leg bone of a giant?" I had to explain that the bones of all the fossil men of whom we have any knowledge do not average any larger than those of modern man and that in all probability the precursor of man was even smaller than man properly so-called.

Man Evolved Very Slowly

If students of human paleontology have had to wait longer for their science to develop, they have one advantage over students of the more lowly prehistoric animal forms in that man has left two kinds of evidence bearing on his past: skeletal remains and cultural remains; whereas other animal forms have left evidence bearing only on their organic or physical evolution.

Not only do we have these two kinds of evidence from which it is possible to gage man's physical and cultural evolution, but the evidence furnished by cultural evolution is the more complete of the two. Cultural change is much more rapid than physical change, hence it can be measured with a greater degree of accuracy, especially during the later periods of prehistoric time. It is probable that tool-using Hominidae lived half a million years ago, although the cultural and anatomical evidence therefor have not yet been found in direct association.

It is now conceded that both brain and body of *Pithecanthropus erectus*, the Trinil man of Java, were more like those of man than of any known ape. Judging from the endo-cranial cast, the cranial capacity was about 900 to 940 cubic centimeters; this compares favorably with the minimum of 930 to 1,000 cubic centimeters in modern man and is 300 cubic centimeters greater than that of the largest gorilla. The cast brings out unmistakably the close resemblance of the lower, or Broca, convolution of the brain (the region of motor control of speech) to that in man. Another notable feature of the cast is the great expansion of that portion of the temporal lobe, which in man is known to be the auditory speech center. In other words, the brain of *Pithecanthropus* was provided with the necessary cerebral mechanism* for the motor control of the speech organs and for the recording of acoustic impressions.

We Need More Facts

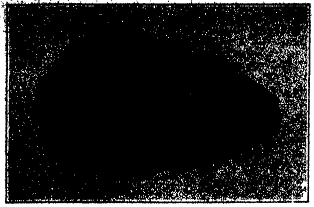
What the science of man's evolution most needs is more data. More—many more—discoveries of fossil man must be made. This work demands trained prehistoric archaeologists. Such scientists are being trained by the author of the accompanying article. Each summer, as Director of the American School of Prehistoric Research in Europe, Professor MacCurdy has led a group of people having serious interest in the problems of man's antiquity through most of the places of prehistoric note in England, France, Spain, Switzerland, Germany and Belgium, for the purposes of education and research. Professor MacCurdy is the author of "Human Origins," a recent and notable work on ancient man.

The development of these two regions having to do (in man) with motor and auditory phases of articulate speech is in harmony with the character of the teeth, lower jaw and brain case. The temporal lines on the sides of the cranium are low and inconspicuous, indicating a very modest development of the muscles controlling the movements of the lower jaw which must have been of correspondingly slight build. The teeth also call for a jaw of relatively light weight; this is especially true of the anterior lower premolars, one of which was fortunately recovered. Professor McGregor, who made a careful study of this tooth, says the facets of wear and the contact area are such as to prove that the upper canine, which is always slightly larger than the lower, was small and hominoid; thus *Pithecanthropus*, with small premolars and canines, must have been manlike in possessing a short dental arch and a chin little if any less receding than that of Neandertal man.

Piltdown Man Used Tools

While no artifacts were found in association with the skeletal remains of *Pithecanthropus* at Trinil, it would be hazardous to assert that he was incapable of their production and utilization. On the contrary the nature of his dentition, mandible, cranial musculature, and brain points to the reverse as being the more probable—a view which is strengthened by the finding in other parts of the world, notably England, of utilized flints in deposits approximately as old as those of Trinil.

If we accept the Trinil premolar as belonging with the cranium of *Pithecanthropus*, and if the lower-jaw fragment found some twenty-four miles east southeast of, and in the same geological level as Trinil



A TOPAZ SCRAPER-KNIFE, 50,000 YEARS OLD

This implement was chipped by an artisan of the Neandertal race, who inhabited a rock shelter in France

belongs to another individual of the genus *Pithecanthropus*, we have a lower jaw of slight build and almost vertical chin in combination with expansive brow ridges. This is just the reverse of the Piltdown combination with its receding chin, prominent canine and brow ridges no more prominent than those of modern man. Either the evidence is faulty or else our knowledge of nature's range in the way of experimentation is incomplete. In time we shall have sufficient evidence to dispel these seeming inconsistencies.

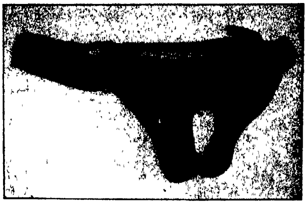
Fortunately at Piltdown, England, where the fossil skull of *Eoanthropus* was discovered, there is a direct point of contact between man's physical and cultural evolution—the association of artifacts with human skeletal remains. This association justifies us in assuming that *Eoanthropus* was a tool user. His mechanical operations were of the simplest kind, consisting first of the utilization of ready-to-hand tools such as the hammerstone or the natural flint flake, both of which may be called primary tools, since they require no preparation for service. The next step was the use of a primary tool, such as the hammerstone, by means of which it was possible to produce an artificial or secondary tool. The Piltdown man's kit of tools was thus a very simple affair.

The discoveries at Ehringsdorf and Taubach, near Weimar, Germany, consisting of chinless human jawbones, teeth, a femur and numerous flint artifacts, reveal another direct association of cultural with skeletal remains. The deposits in which they are embedded are interglacial, hence they are very old, perhaps over a hundred thousand years. There again the artisan's kit of tools remains the same—primary and secondary only—although there is some improvement in the technique. Cultural remains of interglacial man have been unearthed recently in Switzerland, especially at Drachenloch and Wildenmannlisloch; in both, the manufacture of tools did not rise above the secondary class of artifacts.

The great realm of art was beyond the reach of one who could command only the simplest mechanical aids; yet there is not lacking evidence that man was already beginning to reproduce (in his mind, at least) things other than mere tools, to find ways of giving form and encouragement to his mental images. For example, one of the finds at Wildenmannlisloch may serve to throw light on how man first came to be an artist. There is now a good deal of cumulative evidence pointing to the influence of fortuitous resemblances in nature to animal forms as bearing on primitive man's nascent artistic bent. Once detected, natural effigies would be gathered and treasured and means would eventually be found to supplement and improve on nature's haphazard creations. The specimen in question consists of a piece of lower jaw of the cave bear which has a striking resemblance to the human head and body, the concavity of the socket that held the canine forms the neck and chin. The piece bears evidence of a considerable amount of wear as if it had been carried as a fetish.

What Is a "Tertiary" Tool?

When we come to the Mousterian Epoch, or more properly that part of the Mousterian with cold fauna, there are nearly a score of localities where human skeletal and cultural remains are mingled; and they tell a consistent story—always the Neandertalian physical features, such as prominent brow ridges, low forehead, receding chin and scarcely erect posture, and an industry consisting of primary and secondary tools only. In so far as his mental horizon was concerned, there is nothing to indicate his superiority over *Eoanthropus* or the men whose relics we find at Drachenloch, Switzerland, except a slight improvement in the technique of chipping flint. By the time the last glacial epoch reached its maximum, the old Neandertal race and culture had spread over the habitable parts of Europe and the adjacent countries. A variety of the same species was recently discovered at Broken Hill in northern Rhodesia, preparing us for further discoveries of the type in other parts of the Old World

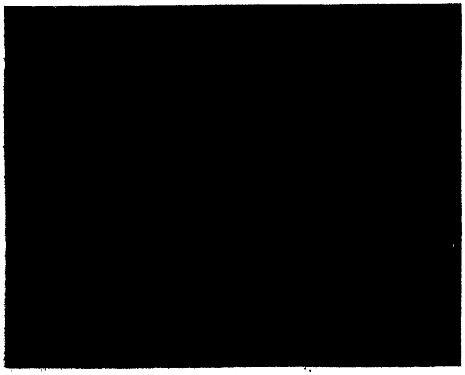


MAGDALENIAN EPOCH JAVELIN THROWER

A good example of a tertiary tool. The handle is missing. The javelin was thrown from the crochet near the tail

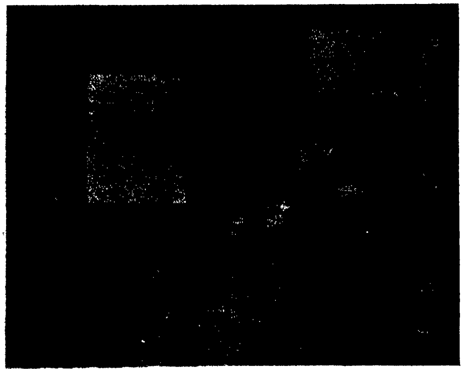
It took a long time, perhaps half a million years, and apparently new blood, to break through the crust which limited the scope of man's activities as an artisan to the use of primary, and the manufacture of secondary tools. The event was a momentous one marked by the appearance of the Aurignacian, or early Cro-Magnon, race with a culture that included a tertiary set of tools—that is to say tools which required the use of primary and secondary tools in their manufacture and which were used for an ultimate purpose other than tool-making. The result from a material and spiritual standpoint can scarcely be overestimated. There followed as a natural consequence the cave-art period which marked the apogee of the food-gathering stage in civilization and prepared the way for the stage wherein man became a food producer.

The great enlightened public was never before so keen as now to follow closely in the wake of prehistoric discoveries. It is the duty of the specialists in this field to satisfy the demand for new knowledge as well as to train the general reader to distinguish between that which is merely spectacular and that which is important from the viewpoint of science. Explorations should, therefore, be conducted only by those specially trained for the purpose, who are equally aware of the significance of the problems involved, and who are versed in the best methods for their solution.



TRENCH DUG IN A ROCK-SHELTER IN FRANCE BY THE AMERICAN SCHOOL OF PREHISTORIC RESEARCH

Two ancient occupation levels, Neandertal and Cro-Magnon, were revealed. Among other objects found in this rock shelter of Castel-Merle, France, was the topaz scraper shown above



Courtesy of the American Museum of Natural History

EVOLUTION AND RELATIONSHIPS OF THE PRINCIPAL BRANCHES OF MANKIND AND THE ANTHROPOID APES

Pithecanthropus *is shown in the "Pliocene" column,* Eoanthropus *almost above it* Neandertal *man on the end of the short branch; Cro-Magnon man is above him*

The New Cosmology

The Hypothesis that Atoms Are Being Evolved in Interstellar Space Is Confirmed by Millikan's Analysis of the Penetrating or Cosmic Rays

By *William Duncan MacMillan*
Professor of Astronomy at the University of Chicago

OUR grandfathers believed very firmly in the cosmogony of the book of Genesis. God made the heaven and the earth, the sun, the moon and the stars, and all the living things that inhabit the waters, the land and the air, in the space of six days, resting from all his labors on the seventh day; and all this occurred some six thousand years ago.

After a lifetime devoted to a mathematical study of the consequences of the law of gravitation as manifested in our solar system, Laplace was much impressed, a little over one hundred years ago, with the uniformities that occur in the motions of the sun's family of planets. Their orbits are very nearly circles; these circles lie very nearly in one and the same plane, the plane of the ecliptic, not very far from the equator of the sun; and finally, the planets all revolve about the sun in the same directions. As far as he knew them, they rotated on their axes in the same direction as they revolved about the sun, and the sun itself rotated in the same direction with them. The satellite systems also exhibit the same uniformities.

Could all this harmony be a matter of accident? Laplace answered with an emphatic "No! the present uniformities in the solar system are evidence of a dynamic past." And he proposed what has come to be known as the Nebular Hypothesis.

Death of the Nebular Hypothesis

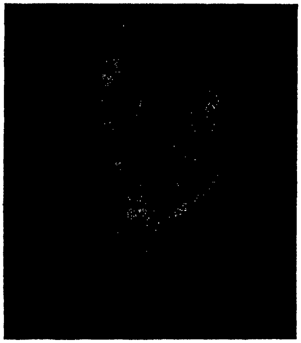
After the foundations of thermodynamics had been laid in the middle of the Nineteenth Century, Helmholz pointed out, in 1854, that the gravitational potential energy of the contracting nebula of Laplace was sufficient to furnish the sun with its present rate of radiation for twenty million years, and that this was more than twice as long a period of time as was required by the most radical of the geologists.

Even we of the second quarter of the Twentieth Century are compelled to admire the simplicity and beauty of the Laplace-Helmholz idea. It coördinated the scientific knowledge of the middle of the Nineteenth Century so harmoniously, and was so attractive in itself, that we are not surprised that our fathers believed in it as confidently as our grandfathers had believed in their conception of the story of creation in Genesis. It dominated the thoughts of scientific men during the entire century, and finally crystallized into a dogma, so that Lord Kelvin, in an address in 1899, stated its conclusions with a confidence and an authority that reminds one of the old Hebrew Prophets when they began "Thus saith the Lord."

For some time previously, however, the geologists had been restless under the restrictions as to time which were imposed upon them by the nebular hypothesis, and Lord Kelvin's address precipitated a revolt. In a paper which in its insight into the possibilities of atomic physics seems almost prophetic, and which was published in *Science* of the same year, T. C. Chamberlin, Head of the Department of Geology of the University of Chicago, sharply, but courteously, challenged not only the conclusions of Lord Kelvin, but also the foundations on which those conclusions rested.

Chamberlin's paper marked the beginning of a new era in cosmogony. Associating himself with F. R. Moulton of the department of astronomy, a mathematician of high attainments, not only were the weaknesses of the nebular hypothesis subjected to adverse criticism, but a new hypothesis was put forward, an hypothesis which Chamberlin called The Planetesimal Hypothesis.

The central idea of the old cosmogony had been rotational instability: rotational instability of gases in the nebular hypothesis of Laplace; rotational instability of liquids in the fission theory of Poincaré and Sir George Darwin as to the origin of the moon. The central idea of the new cosmogony was the close approach, but not collision, of two stars, one of which was our own sun.



PROF. T. C. CHAMBERLIN

Noted geologist of the University of Chicago who, with Prof F. R. Moulton, developed the Planetesimal Hypothesis

It was a bold flight of the imagination, for never before had contact with the outside universe been brought seriously to our consideration. The inception of our family of planets was bi-parental, not mono-parental as had formerly been thought.

Much study has been given to the planetesimal hypothesis during the quarter of a century which has just elapsed, but it has stood the tests well. No fatal flaws have developed. There are many difficult problems, to be sure; but nature very rarely places problems that are mathematically simple before us, just enough, perhaps, to keep us struggling forward without complete discouragement.

Many astronomers and geologists, perhaps most of them, believe that the Planetesimal Hypothesis sketches in the large outlines of the past history of the earth and her sister planets. Filling in the details will be the work of the future.

The problems of cosmogony have been a favorite theme for more than a century, but the gigantic strides of the physicists and the observational astronomers for a generation past have placed before us a field even larger than that of cosmogony, the cultivation of which I have ventured to call cosmology. As used hitherto, the word "cosmogony" means the study of the origin of those forms which are visible in the sky—and therefore it deals with the past. Its significance might well be extended to include the origin of cells, crystals, molecules, atoms and electrons. The origin of cells, crystals and molecules has received a great deal of attention, but there has been very little discussion of the origin of atoms and electrons.

The term "cosmology" signifies the effort to coördinate all of the physical processes which we can detect in the visible universe, and to derive from that coördination all of the inferences which logically flow from it, whether they refer to the past, the present or the future. It represents the widest possible aspect of the transformations of energy and of those temporary localizations of energy which we call the physical units—electrons, atoms, crystals, stars, and so on; for I take it that we have all learned the lesson that in the study of the physical units we find nothing but energy and *organization*: that solid, unorganized, little something or other which we thought of as "matter," has vanished into the realm of myths.

In studying the physical units, therefore, we have to deal only with energy and the properties of its organization.

Science Does Not Recognize Creation

The foundations for the study of the motions of the celestial bodies were laid by Newton when he formulated the laws of motion and the law of gravitation, and developed the mathematical machinery (the calculus) which is necessary for tracing out the consequences of these laws. The tremendous successes won by the students of celestial mechanics, from Newton to Poincaré, have been considered by many as the crowning glory of the human intellect. When we rise, however, from the study of local systems, such as our planetary system, or binary and multiple stars, to aggregates of stars such as globular clusters or star clouds, the number of the objects to be dealt with is so great that we are compelled to resort to statistical methods for such meager information as we possess.

Nevertheless, thanks to Charlier and Kapteyn and many others who have followed in their lead, we have a certain fund of information with respect to the dynamics of stellar aggregates, such as the globular clusters, star clouds, or even such an aggregate of star clouds as our own galaxy, which is very precious. As might be expected *a priori*, the time-scale for these vast objects rises with the linear-scale, so that observable changes in their internal organizations are to be measured in thousands of billions (10^{12}) or even millions of billions (10^{15}) of years.

One of the fundamental events in such an aggregate is the close approach of two stars. If for the sake of a suitable unit we call a million billion years an "eon," then the expectation of the sun that some other star will approach it as close as the earth does, is *once in four eons*, on the average. To one who is accustomed to such periods of time as were granted by the Helmholz theory of the origin of the sun's heat such figures seem fantastic and unreal, and they were dismissed at first as such, with a feeling, unexpressed perhaps, that the galaxy had been created much more recently than that.

Science, however, does not recognize "creation," for it has no means of dealing with it. These vast similar aggregates are there, before our very eyes, and these vast periods of time go with them. We cannot dodge the facts, however startled we may be. Nor can we believe that the stars were all dark and cold until a hundred million years, or so, ago, when they all suddenly became bright, virtually simultaneously, and that in a few more million years they will all be dark again, their energies spent and gone. We cannot doubt that, however much the brightness of the individual stars may fluctuate, the aggregate as a whole has been shining as we see it now for periods of time that are to be measured by eons.

In the face of such a situation how pitifully inadequate is the contraction theory of the origin of the sun's heat!

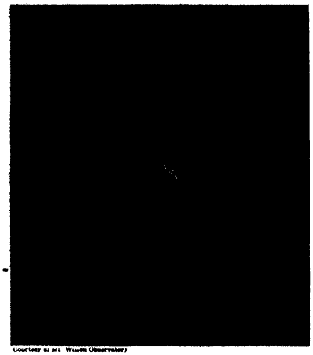
The Cycle of Energy

Meditating upon these difficulties some ten years ago (1915); wondering at times what becomes of the vast floods of energy which the billions of stars are pouring unceasingly into space, notwithstanding that space is still dark and cold; and wondering, at other times, whence came the great stores of energy which the physicists were revealing in the atoms, there occurred to me the possibility that the birthplace of the atoms was in the depths of space, and that the source of their energies was the radiant energies of the stars.

The hypothesis that this is so accounts for the blackness of the night skies, and it accounts, too, for the existence of that nebulosity of space with which the cosmogonists have been wont to start their systems. It does more than that: it solves the problem of the stellar energies. If the radiant energy in space can be locked up in a new organization, an atom, which possesses the properties of mass and gravitational attraction, where mass did not exist before, then under the violent stresses which exist in the interior of the stars that organization can be destroyed, and its energy, released, again will take the radiant form.

One can account for an indefinite period of luminosity by merely supposing that the stars gather in as much energy in the form of nebulous matter as they radiate in the form of light and heat.

This suggestion, which harmonizes well with the astronomical facts and seems to have no fatal encounters with any of them, was published in the *Astrophysical Journal* in 1918. In the following year it was found that the physicists had already prepared a model in the theory of the electrons which responded to all the requirements of the case.


Courtesy of Mt. Wilson Observatory

A GREAT SPIRAL NEBULA ON EDGE

Doubtless this universe of suns is similar in a general way to the one shown below

If a positive and a negative electron unite in such a way that there is an exact superposition of their electrical fields, then their electrostatic potential energy would take the radiant form and the combined unit would not possess the property of mass, since mass depends upon the existence of the electrical fields. Furthermore, if the distance at which the potential energy takes the radiant form is the radius of the positive ion, the amount of energy can be computed. It is so great that the present mass of the sun would last for fifteen thousand billion years! The physicists have indeed relieved that embarrassment of the astronomers at the Bank of Time, and we are grateful to them for it.

The suggestion that a positive and a negative electron may neutralize each other with the loss of the property of mass, however, is not altogether new. So far as I know, it was first put forward by Jeans in 1904 in an effort to account for the phenomena of radioactivity. It did not seem to fit that situation, and the idea was not further developed.

In 1905 Einstein showed that, in accordance with the principle of relativity and the electromagnetic equations, one gram of matter is equivalent to 9 x 10^{20} ergs of energy, a figure that differs by about two percent from that which has just been derived from the electrostatic potential energy. Einstein further remarked that, on account of the radiation of its energy, the mass of the sun was declining at the rate just mentioned. He made no suggestion as to the origin of the sun's heat; doubtless because he was too busy developing other ideas. It might be added that hypotheses similar to those described above have been put forward in the past eighteen months by Jeans and Sir Oliver Lodge in England and by Nernst in Germany.

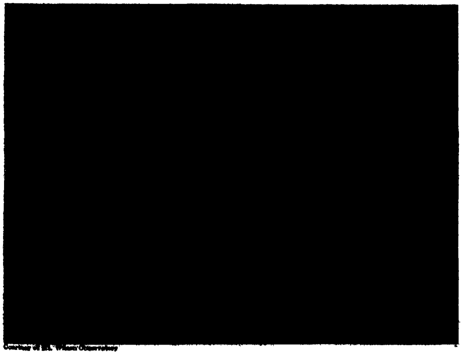
The hypothesis that atoms are being evolved in interstellar space, with a consequent loss of radiant energy, and that they are being destroyed in the interior of the stars, with a consequent release of radiant energy, leads to a wonderful expansion of our cosmological ideas Atoms are certainly being evolved somewhere, and their large numbers suggest the depths of astronomical space Millikan's recent conclusion from his analysis of the penetrating radiation, that something having to do with the nucleus of the atoms is going on in interstellar space, is a striking confirmation of the hypothesis The evidence has come much more quickly than anticipated.

The Earth's Final Fate

There is not space in the present article to develop the consequences of this cycle of energy—from star to atom, and from atom to star—but I cannot refrain from mentioning a natural extension which it suggests to the Planetesimal Hypothesis of Chamberlin and Moulton. Planetary systems have their origin in the close approach of two stars, and in view of the eons during which the galaxy has existed, planetary systems must be numerous throughout the galaxy and many of them much older than ours

This leads us to enquire "What is the old age of a planetary system?" The answer is that during the long ages of galactic time the planets, too, gather in meteoric and nebulous matter, and grow As they grow they draw closer together and their mutual perturbations increase. In our own system the smaller, terrestrial planets, one by one, doubtless, will be thrown into the sun. Jupiter will grow up to starhood Quite likely the outer planets too, eventually, will meet the same fate as the smaller ones, and the sun and Jupiter alone will be left to form a binary star. Youthful planetary systems become binary or multiple stars in their old age.

The revolt which was led by T C Chamberlin against outworn ideas twenty-seven years ago has been most fruitful in its consequences


Courtesy of Mt. Wilson Observatory

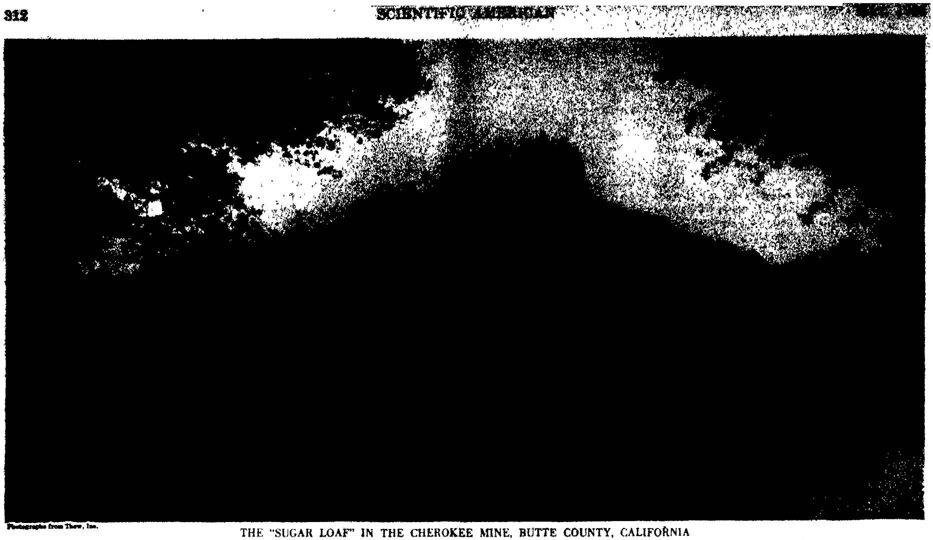
IMMENSE ERUPTIVE PROMINENCES OF THE SUN

"At short intervals great bolts of sun-substance are shot forth at high velocities," says Chamberlin in "The Origin of the Earth." Should another sun now pass by, planets might be born

Courtesy of Mt. Wilson Observatory

SPIRAL NEBULA CONTAINING MILLIONS OF SUNS

Prof. MacMillan suggests that the Penetrating Radiation, recently studied by Millikan, may be generated when atoms are being evolved in the depths of interstellar space



Photographs from Thew, Inc.

THE "SUGAR LOAF" IN THE CHEROKEE MINE, BUTTE COUNTY, CALIFORNIA

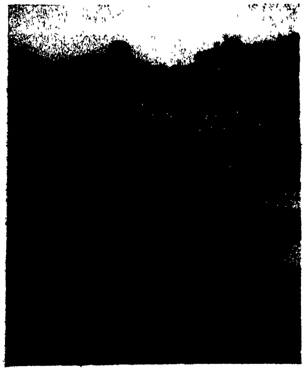
Many years ago a miner sent a prospect tunnel into Sugar Loaf and found what is believed to be a chimney of diamondiferous blue ground

A Diamond Quest in California

Cherokee Mine, Once One of the Richest Gold Producers, May Now Become a Diamond Mine

By Winfield Scott

SOMEWHERE in the Cherokee Mine, located twelve miles north of Oroville, California, there is believed to be a blue clay pipe or chimney which carries diamonds. Several hundred diamonds have been found in this mine, but no systematic search for this chimney has ever been made.



READY FOR PANNING

Panning was one of the operations incident to early day gold mining. Our photograph shows one of the miners, William Fliedner, better known as "Happy Jack," on the job

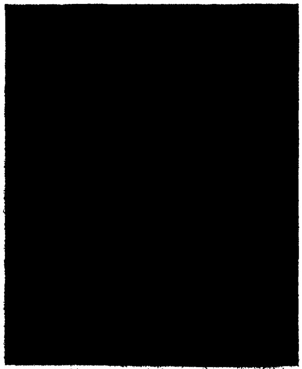
Many years ago Alexander M. Wilson, a miner who lived in Cherokee forty years, sent a prospect tunnel into what is known as the Sugar Loaf, at the Cherokee Mine. Wilson remembers very distinctly running across a formation of blue ground, which corresponds in every particular to the description of the blue ground which is mined at Kimberly, South Africa. This ground carries the largest portion of the diamonds which now come from South Africa.

Always a Rich Gold Producer

Cherokee has always been a great gold property. It produced millions of dollars before hydraulicking was stopped in California many years ago. After hydraulicking ended, the owners of the property, the Vintin family, never made arrangements for an impounding dam in which the hydraulic mining debris could be retained and thus prevented from falling into the tributaries of the Sacramento River. Lack of funds alone has prevented a debris dam from being constructed and the Cherokee Mine from continuing as one of the state's largest producers of gold.

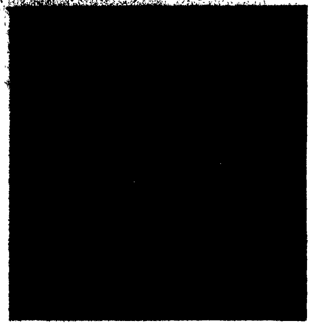
Some years ago the water right to the property was sold to a public service corporation operating in California, and now the great Cherokee Mine, once one of the richest gold producers in California and still containing literally millions of dollars in gold dust, lies idle. Engineers have said, however, that several practicable sources of water are still available.

With the water gone and with debris impounding not solved the days of the Cherokee as a gold producer appear to be over. There it is, a great pit torn out of the side of the hill and out of a valley; perhaps five miles long, perhaps two miles wide. Over it broods silence and the sun. The bed of the mine is one great mass of boulders, some as large as an ordinary sized room. In and around these boulders individiual miners are digging away for "muck," which they wash in the most primitive



ANOTHER MINING OPERATION

Getting out "muck" (gravel) from between the boulders in the bed of the Cherokee Mine. The gravel is sifted and examined for diamonds before being washed for gold



TWO EARLY-DAY METHODS

Fliedner, in manipulating his pan, found a globule of quicksilver in a ditch running away from the Cherokee Mine. It had evidently been lost in early mining operations

manner and out of which come some diamonds as well as gold.

Several hundred stones in all have been found since 1866, when Mike Maher, a Cherokee miner, picked up what is said to be the first stone discovered in the district.

Campbell De Beck, a Belgian, mined with a group of fellow countrymen in the early 80's and found eighty stones. Louis Slissmar, an Oroville theatre owner, declares that his father, who once mined at the Cherokee diggings, found twenty stones incidental to his gold mining operations.

Blue Ground Stimulating the Search

All the diamonds thus far discovered in the Cherokee Mine show little effect of water washing either by chipping or otherwise. The crystalline structure of the diamonds is spendidly preserved. This fact is taken as proof, by the three or four men who are unostentatiously digging in the bed of the mine that the original source of the stones is not far away This circumstance and the location of blue ground found by Wilson many years ago, are stimulating the present search.

Douglas B. Sterrett, of the United States Geological Survey, reported in 1906 in regard to a spasmodic effort to locate the original source of the diamonds as follows:

"Just what the nature of the matrix will be is not known. It may not be a typical kimberlite rock and in the form of a volcanic neck, but one of the great varieties of basic igneous rocks so plentiful in the region. It has not been proved that a kimberlite in formation is essential to the occurrence of diamonds nor that where such a rock exists it must carry diamonds."

Aside from the little known, although recently reported, diamond discoveries in Arkansas, not much can be said for diamond working in the United States. Schoolboys of an earlier era were told in their text-books that the largest diamond ever found in the United States was one of 23¾ carats which was picked up in 1885 in Manchester, Virginia. This stone was in later years known as the Dewey diamond.

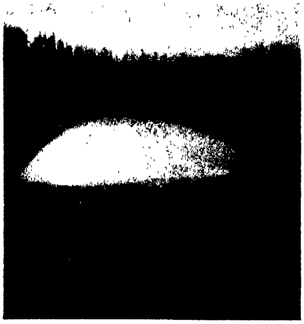
A PROSPECTOR'S FIND

Diamonds and gold from the Cherokee Mine. At the left is shown a cut diamond set in a ring, in front of it a rough diamond A pile of gold nuggets of varying sizes and in great abundance is shown at the right

Diamonds have been reported in Virginia, Georgia, South Carolina, North Carolina, in the Eastern Appalachians, and also in Wisconsin, Michigan and Ohio. Middlewestern finds have always been in the glacial drift; and the original location is usually supposed to have been somewhere in the north, in the Hudson Bay country.

The miners who are hopefully prospecting the Cherokee property in California are not looking for diamonds in gravel, and yet it must be remembered that prior to the discovery of the South African mines the only source of these gems was from river gravel.

The Golconda district in India was exhausted about the Seventeenth Century, and no large diamonds were found prior to 1000 A D. Golconda itself was merely a market for the stones, which were obtained from a district on the east side of the Deccan all the way from the Pinner River in the Madras Presidency to the rivers Sun and Kahn, which are tributaries of the Ganges



A THING OF THE PAST

In the early days, hydraulic mining was employed at Cherokee Mine This form of mining was stopped long ago, however, and is now all but a memory in California

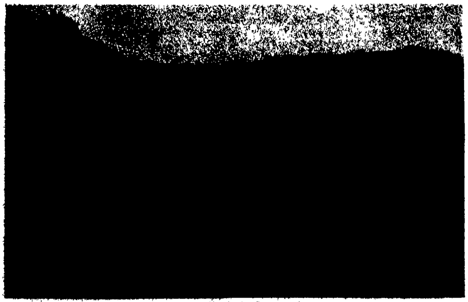
A Precious Plaything

The Brazil diamonds, which were first known about 1725, remained the principal source of new stones until 1867, when the children of Daniel Jacobs, a Boer farmer near Hope Town on the Orange River, picked up a bright, white stone and used it as a plaything. It was a diamond weighing 21 8/10 carats.

From the finding of this stone by a child dates the modern history of South Africa.

In British Guiana and in Borneo there is some diamond production. Diamonds have come also commercially from the Ural Mountains and New South Wales.

The plans of the prospectors in the Cherokee Mine have been carefully covered up. There is no doubt that there are diamonds in the mine, and that should the precious matrix in which they hide be discovered, Cherokee, a dwindling mining town of '49, will be re-born and will be the scene of all the bustle and excitement of former days



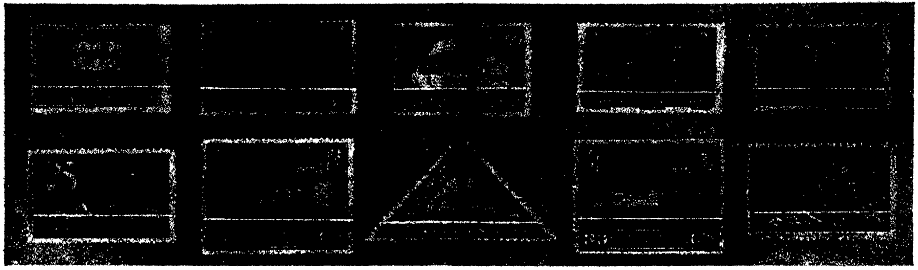
BED OF THE CHEROKEE MINE

In this mine, many years ago, diamonds were found. The "blue ground" chimney, in which the diamonds were formed, is believed to be somewhere in the "Sugar Loaf," at the left

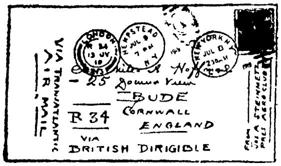
ALL THAT REMAINS OF CHEROKEE

Once a busy town, straggling for a mile along the roadway, it is now a place that lives in the past. Perhaps, some day, it will be once more the scene of feverish activity

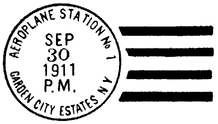
Interesting Air Stamps and Historic Cancellations



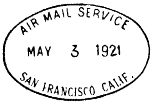
Some of the choicest examples of air stamps—aviation's contribution to stamp lore



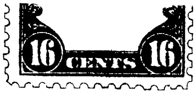
Card carried by the Airship R 34 on the record transatlantic trip



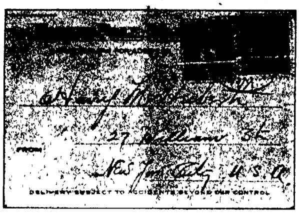
First cancellation of a regular trip carrying mail



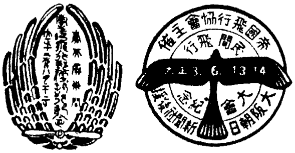
Cancellation first trip San Francisco-New York



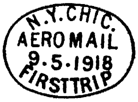
All Uncle Sam will let us print of our air stamps



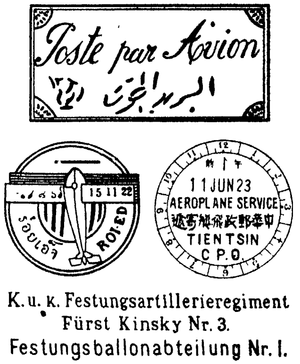
Amundson took a limited number of postcards on his polar expedition



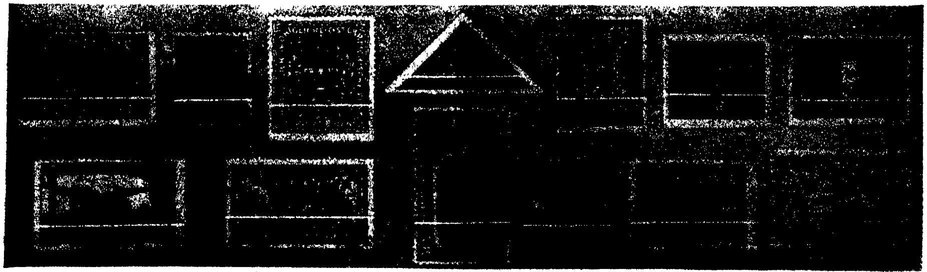
Japanese cancellations are very artistic



Cancellation first New York-Chicago mail



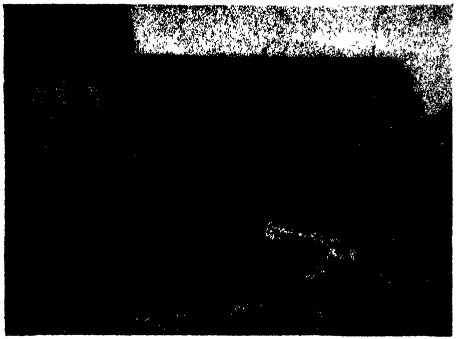
Cancellations of Turkey, China, Siam and a military cancellation during the siege of Przemysl



The air stamps of all nations furnish a happy hunting ground for the stamp collector

HIGH TIDE AT PASSAMAQUODDY

The Bay of Fundy experiences the greatest tidal range of any known body of water. In places this is from 40 to 50 feet



LOW TIDE AT PASSAMAQUODDY

Compare this with the adjoining photograph, taken at the same spot, and you will appreciate the latent tidal power of these waters

Horsepower From the Tides

Proposal to Develop Half a Million Horsepower at the Bay of Fundy

By J. Bernard Walker

FROM time to time, we have recorded in the Scientific American various attempts to utilize the energy of the sea, as expressed in its undulating waves or in its ebbing and flowing tides. One of the latest of these attempts and certainly the most ambitious, was the proposal (since abandoned) to build a great dam and power house across the River Severn and thereby secure a continuous supply of hydro-electric energy of 500,000 horsepower.

And now comes a well-known hydraulic engineer, Mr. Dexter P. Cooper, who has done notable hydraulic work, particularly in connection with the construction of the great Keokuk Dam across the Mississippi, with a proposal to harness for industrial purposes the famous tides of the Bay of Fundy.

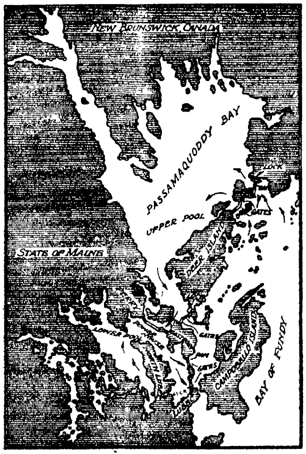
A Stupendous Undertaking

Mr. Cooper has selected for his stupendous undertaking two considerable indentations off the eastern coast of Maine—one known as Passamaquoddy Bay and the other as Cobscook Bay. These two bodies of salt water adjoin each other and are almost completely shut off from one another and from the waters of the Bay of Fundy by a continuous chain of islands. The islands are separated by narrow inlets, through which the tide enters and leaves the two bays. The northerly or "upper pool" has an area of 106 square miles; the "lower pool" has an area of 46 square miles. Now, it was the topographical lay of the land and sea at this point which suggested the possibility of utilizing the rise and fall of the tide for power purposes.

"I will enclose the two pools," said Mr. Cooper, "by building a series of dams between the islands and provide them with regulating gates to control the inflow and outflow of the tidal water. I will so regulate the flow that the large upper pool shall be maintained at a relatively high level and the lower pool at a relatively low level, thus obtaining a permanent hydraulic head. Then, by building a dam between the two pools, I can place my turbines within it and secure a continual operation of the turbines throughout the 24 hours of the day."

The flow of the Bay of Fundy water is always *into* the upper pool as shown by the arrows. Also, as shown by the same indications, the flow at the power house is always from the upper to the lower pool, and from the lower pool the flow is always *outward* into the Bay of Fundy.

The total cost of the project will be about $100,000,000, and the dams with their gates will total about 14,500 feet in length. As shown by the map, the principal island off Passamaquoddy Bay is Deer Island and north of it there will be two dams, each provided with gates for the control of the water. At the northerly dam, there will be a lock. A dam will also be built from Deer Island to the land near Eastport. Between Eastport and the mainland, there will be two other dams, each provided with gates for the outflow of water from the lower pool. The dam near Eastport, must be built in water that is 175 feet deep, and flows in and out of the pool with considerable velocity. It is proposed to fill up this gap by dumping large boulders until the structure has reached the surface. Above that point, smaller rock would be used on the side facing the pool and the structure would be rendered tight by a mixture of clay and gravel.



HOW THE POWER IS DEVELOPED

Map showing the system of dams, gates and turbines by which it is expected to develop 500,000 horsepower

Every one of the dams will be provided with gates for the control of the water level in the two pools. Twenty gates will be required for the upper pool and ten for the lower pool. In addition to the locks mentioned above, at the northerly end of the chain of islands, there will be another lock at the Deer Island end of the large dam. This lock will be 800 feet long, 110 feet wide, with 30 feet of water over the sill.

Controlling the Tidal Fall

At high tide, the gates into the upper pool will be closed and, as the upper pool water passes through the turbines to the lower pool, it will continue falling until its level reaches the level of the next rise in tide outside the gates, when the gates will be opened and the pool will be filled again to high-tide level.

The lower pool will reach its bottom level at low water of the Bay of Fundy. The gates will then be closed, and as the water passes through the turbines of the power house, the surface level of the lower pool will rise until it reaches the same level as the falling outside tide, at which point the gates will be opened allowing the level in the pool to fall to low-tide level. By this arrangement of dams, controlling gates, and turbines, between the two pools, there will always be maintained a sufficient head of water for operating the turbine continuously. Mr. Cooper estimated that the maximum head would be 24 feet, the minimum head 10 feet and the average head throughout the 24 hours would be from 14 feet to 15 feet. The total output at low head will be 500,000 horsepower.

A Way to Conserve Our Valuable Timber Supply

How Industrial Wood Preservation May Help to Save Our Fast Disappearing Forests

By R. K. Helphenstine, Jr.

OF all the products of the earth, wood has probably been the most valuable to and most closely associated with the human race in its advance toward civilization.

Aside from being a daily essential to man's individual welfare, wood has been a raw material indispensable to the birth, growth and very existence of great national enterprises. Navigation, the construction and maintenance of railroads, the perfection and upkeep of telephone and telegraph lines, the operation of mines, and many other large industries have always been and will continue to be dependent upon a continuous supply of timber of high quality in various structural forms.

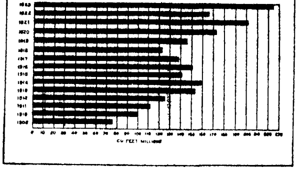
Light in weight, strong, readily adaptable and low in price, wood is the ideal material for construction. While all wood is not durable, it can be made so at small cost by preservative treatment, and there is a preservative and a method of applying it suitable for practically every need.

Our Vanishing Forests

Official government estimates place the original forest area of the United States at 822 million acres, representing a stand of at least 5,200 billion board feet of timber. Today, only 463 million acres of forest land remain, supporting approximately 2,214 billion board feet of merchantable timber, or less than two-fifths of the country's original forest wealth. Furthermore, only one-sixth of the original forest area now remains in virgin timber

The total amount of wood used and destroyed annually in the United States amounts to approximately 25 billion cubic feet. This includes lumber and timber, crossties, piles, poles, fence posts, mine props, and the various other classes of primary products for which wood is the raw material used. It also takes into account four billion cubic feet, the estimated annual preventable loss of wood in service through decay alone. As compared with this enormous consumption, it is estimated that but six billion cubic feet of wood is produced through annual growth.

In other words, therefore, the standing timber of the country is being cut and destroyed nearly four and one-half times as fast as it is being replaced by growth. At this rate of consumption it can be readily seen that unless vigorous action is taken at once looking to conservation and reforestation the remaining supply of timber will last but a comparatively short time. The nation must, therefore, in order to meet future requirements, not only grow timber, but must also practice the most strict economy in the utilization of that which remains. Wood preservation presents one important channel through which such economy can be rigidly enforced.



WOOD TREATED IN THE UNITED STATES
The wood-preserving industry has shown a truly remarkable growth

Wood, although possessing as wide a range of uses as any other raw material, has always been handicapped by the fact that, when exposed to conditions fostering decay, it may last but a comparatively few years. One of its great advantages in past years has been its relative cheapness; but, as a result of timber depletion, this advantage has been growing steadily less as the cost of wood has mounted higher and higher. To lay a section of railroad track, to timber a mine tunnel, or to construct a bridge with woods best suited to each class of project costs today several times as much as it did twenty years ago.

The gradually increasing difficulty in obtaining the more adaptable woods of the correct size and quality is the cause in no small part for the increased cost, as well as for the tendency to substitute poorer species. Thus the scarcity and resultant high price of the better woods and the exceedingly short life of the cheaper ones presented a problem, the solution of which gave birth to the wood-preserving industry.

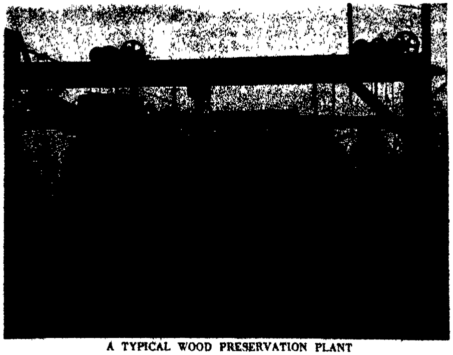
The preservation of wood does more than merely prolong its life. It permits of the use of less durable woods that were formerly considered unsuitable, but which, when treated, will last as long as any others. It gives the user a wider field of selection for his material and enables him to obtain satisfactory stock at a reduction in cost. It often permits of the use of local species, thus obviating high transportation costs. It lessens the demand for the better species, thus making them available for more exacting uses.

Methods of Preservation

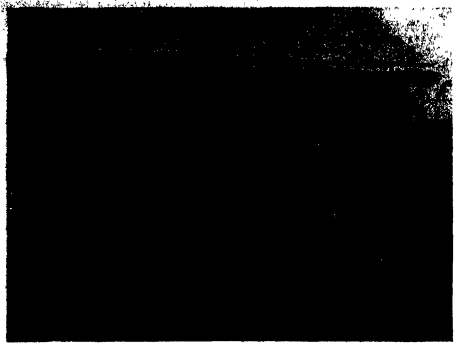
Coal-tar creosote and zinc chloride are the two preservatives that have become standard in commercial practice in this country and are used in the largest quantities. Others are also employed, however, such as mercuric chloride, sodium fluoride, paving oil and a number of proprietary preservatives, but usually only in relatively small quantities for special purposes. Coal-tar creosote is used for the treatment of wood for all classes of construction. Zinc chloride is soluble in water and is liable to leach out of wood when placed in wet situations. For this reason its use is largely confined to the treatment of timber for building and other construction in comparatively dry locations. In the southwest and other regions where there is a minimum of rainfall it is extensively employed in the treatment of crossties. This preservative is also admirably adapted to the treatment of wood in house construction, where it is usually painted or where the color or odor of creosote would be objectionable.

The essential properties of a satisfactory wood preservative are that it should be poisonous to wood-destroying fungi and insects, that it should not weaken the wood, should be of uniform composition, and should be available in large quantities at low cost. Coal-tar creosote and zinc chloride have been

A PRESSURE TREATING CYLINDER
This close-up view shows the detail of the door construction the arrangement of the heating coils and the comparative size of the cylinder



A TYPICAL WOOD PRESERVATION PLANT
The cylinder on the left contains timber undergoing treatment, while that on the right is open and ready to receive timber for treatment



BEFORE TREATMENT
A load of crossties entering cylinder for preservation treatment

AFTER TREATMENT
A trainload of crossties shortly after removal from cylinder

found to meet these requirements most successfully.

In the preservation of wood, treatment is applied either by pressure or non-pressure methods. The former is the more effective, because the preservative is forced into the wood under pressure and deeper impregnation is secured. Furthermore, under the pressure method, penetration is subject to control, and both the penetration and the preservative can be varied to meet different requirements, thereby resulting in the economical use of preservatives.

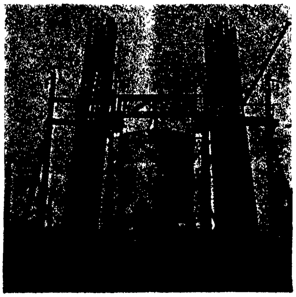
Preserving Industry Has Trebled in Size

Although the pressure treatment of wood gives the best results, the material to be treated frequently does not warrant the expense necessary to install the requisite equipment for this type of treatment, and non-pressure methods are employed. These comprise the hot and cold bath, soaking, dipping, and the brush coating or spraying methods. Of these the hot and cold bath (open tank treatment) is the method most commonly employed commercially, especially in the butt treatment of poles. For the dipping, soaking and brush coating methods creosote is the preservative ordinarily used, while in the open-tank method either creosote or zinc chloride is employed. Where the timber is well seasoned and treatments are carefully made the added life secured by non-pressure treatments fully warrants the expense.

A modern pressure wood-preserving plant consists mainly of one or several treating cylinders six or seven feet in diameter and from 80 to 170 feet long. These cylinders are sufficiently strong to withstand a working pressure of from 125 to 200 pounds per square inch, and are provided with coils inside for heating the preservative. The cylinders are mounted on foundations in a horizontal position and are fitted inside with a narrow-gage track to carry the tram cars containing the wood to be treated. In operation the cars with their loads of timber are propelled into the cylinder in trains, and the door at each end is closed. After treatment, the material is removed and loaded for shipment." In addition to the treating cylinders a pressure plant is also equipped with storage and measuring tanks for the preservative, the necessary pressure and vacuum pumps, and apparatus for steaming the timber preparatory to treatment when necessary.

In 1909, the first year for which statistics of the industry were gathered, there were in existence in the United States a total of 64 treating plants. In 1923 the number of treating plants that were in active operation was 135. Of these 81 are commercial plants that treat wood for sale or by contract, 29 are owned by railroads and specialize in the treatment of railroad material, and 25 are private plants belonging to mining companies or public utility corporations that treat wood in various forms for their own use.

The plants that were active in 1909 consumed 51,426,212 gallons of creosote and 16,215,107 pounds of zinc chloride, as compared with 127,417,305 gallons of the former and 28,830,817 pounds of the latter that were used by those plants that were in operation in 1923.



A COMMERCIAL OPEN TANK PLANT
The non-pressure method is most commonly employed commercially for the butt treatment of poles

In 1909 the total quantity of wood treated was 75,946,419 cubic feet, while in 1923 that which was subjected to treatment amounted to 224,375,468 cubic feet.

From the above statements it can readily be seen that in a few short years the wood-preserving industry has shown remarkable growth.

The railroads, the pioneers in the wood preserving field, have long been cognizant of the economic value of treated wood. As a result, the bulk of the material treated each year has consisted of crossties, crossing plank, bridge and trestle timbers and similar products of the forest in structural form essential to the profitable and safe operation of the rail transportation system of the country.

The splendid example set by the railroads has been followed increasingly each year by other large industries. Mining companies are now important users of treated wood in the form of props, and other mine timbers; telephone and telegraph companies depend upon treated poles and cross-arms to insure permanency in their equipment, and docking and terminal and constructing companies draft their specifications for structural timber with special reference to preservative treatment. Furthermore, in the national and state programs for public works, highway construction, and the improvement of navigation, treated wood plays an important part in the form of bridge timbers, fencing, guard rails, piling, foundations, and so on.

Treatment Doubles Life of Wood

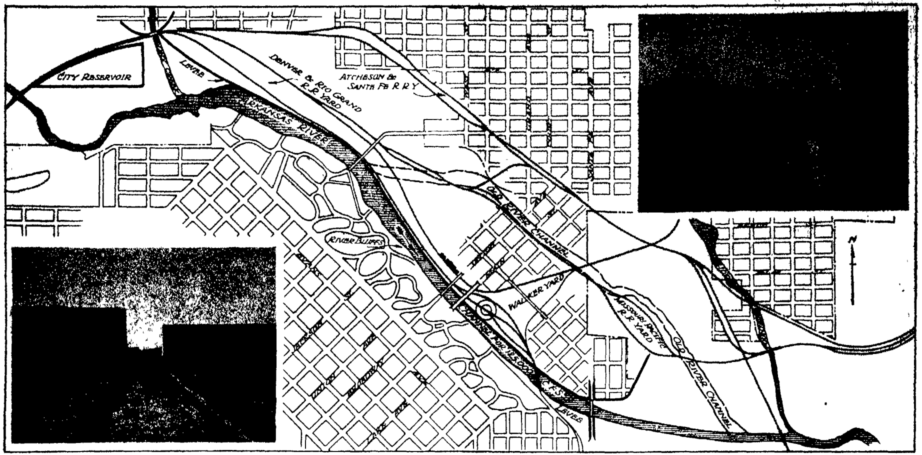
Although wood preservation has made wonderful strides in this country, there yet remains much to be done in spreading the gospel of treated timber.

Today, the preservative treatment of wood is standard practice with many large users of crossties, piles, poles, paving blocks, cross-arms and construction timbers. The field is so broad, however, that it could readily be extended to all other users of such material as well as to many additional classes of wooden commodities. In the erection of any dwelling house, public works or other structure, built wholly or partly of wood, there is some material which it would be advantageous to treat, and through its treatment a real economy would be effected, not only in an actual saving in dollars and cents, but a saving of the timber supply of the nation.

The average life of an untreated crosstie is estimated to be seven and one-half years, while the same tie subjected to pressure treatment will last fifteen years or more. Well treated ties frequently have to be removed on account of wear rather than decay.

Untreated piling on an average fails, from decay or the attack of marine borers in sea water, in from one to four years, and lasts up to a maximum of from 12 to 15 years when used in fresh water or on land. This same class of material when given full pressure treatment with creosote will give from 15 to 30 years' service or even more, depending upon the use to which it is put.

Treated sap-pine posts have been found to be in good condition after 30 to 40 years in the ground. Untreated, they have to be renewed in from two to five years.


City Reservoir
Levee
Denver & Rio Grande R.R. Yard
Atchison & Santa Fe R.R.Y.
Arkansas River
River Bluffs
Old River Channel
Walker Yard
Channel for 125,000 C.F.S.
Missouri Pacific R.R. Yard
Old River Channel
Levee
N

The 1921 flood destroyed the business section of Pueblo. The old channel capacity 38,000 feet per second, was overflowed by the flood of 100,000 feet per second. This map shows the new channel of 150,000 cubic feet per second capacity. LOWER VIEW: *Rock Canyon Barrier.* UPPER VIEW: *Stretch of the new channel*

Western City Ends Flood Menace

Moving a River Half a Mile Across the City of Pueblo

By J. E. Murphy

If an observer, gifted with prophetic vision, had stood in the midst of the devastated area of Pueblo, Colorado, the day after the flood of June, 1921, and had looked four years into the future, he would scarcely have believed what his vision revealed.

As matters stood then, the city was indeed hard hit, with the heart of its business district wrecked apparently beyond repair. And that was not all. Stretching west to the mountains was the drainage basin of the Arkansas River, a triangle containing 1,800 square miles of mesas and foothills, with steep slopes and impervious soil, subject to the cloudbursts of the mountain country. From the same source would come other floods, greater, perhaps, than the one just past, and in time the disaster was sure to be repeated.

Rebuilding a Wrecked City

But on the fourth anniversary of the flood the same observer would have found the devastated area rebuilt along better lines, with no evidence of the disaster except an occasional high-water mark on some brick building. For, dealing with the peculiar flood situation that has menaced the city from the days of the first settler, he would have found a protection system capable of taking care of the biggest flood the Arkansas can ever send down the valley.

When the engineers came on the ground to work out a system of protection they found a difficult situation to deal with. Their first problem was to determine the greatest flood that could come out of the region west of the city. The next, was to design and build protection that would take care of that flood with a liberal margin of safety.

The valley of the Arkansas cuts through the middle of the city. In this valley lie the greater part of the business district, important terminals of three railroads, and a small residence district. The valley is bounded on the north by gently rising slopes and on the south by the bluffs at the north edge of the section of the city, known as the Mesa.

There is something that appeals, or should appeal, to our sense of the dramatic in the vast and, we had almost said, audacious works by which the civil engineer has met and mastered the floods of the Arkansas which wrought such frightful havoc on the fair city of Pueblo in 1921. Throwing forward, as an outpost to meet any on-coming flood of the future, a massive barrier wall stretching clear across the valley some six miles above the city, he then swung the river over against the bluffs on one side of the city and deepened and widened it until it was capable of taking care of any possible flood and of passing the turbulent waters harmlessly through the city.

The matter of cost made it impracticable to resort to the simplest solution—a channel big enough to deal with any flood that might come.

The key features of the protection which were finally worked out are a channel through the city, capable of carrying a flood one and a half times as great as that of 1921, and a retarding dam, or "barrier," west of the city for cutting down the peak flow of greater floods.

The peak flow of the 1921 flood was slightly less than 100,000 cubic feet per second, or "second-feet," as commonly called, this stage being reached at one o'clock at night.

The old river channel had a capacity of only 38,000 second-feet. There was only one possible result, and for several hours swift currents swept through the streets at a depth of from 9 to 14 feet. The new channel has a capacity of 125,000 second-feet when filled to a depth of 27 feet, and at this depth the velocity of flow will be 23 feet per second.

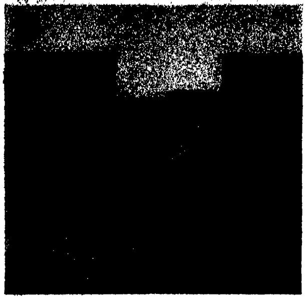
Owing to the liberal freeboard and the extra capacity given by a parapet wall that tops the north bank for a distance of 6,000 feet at the lower end, the channel in an emergency could carry a flood of 150,000 second-feet. But that would be its limit.

How River Was Moved

In their study of the situation the engineers found that the old river channel was not only too small but that it was too crooked and was in the wrong place. Accordingly, the river was moved half a mile across town to a comparatively straight course along the foot of the Mesa bluffs, where an expert city planner would probably have located it in the first place.

The diversion of the river begins 6,000 feet west of Union Avenue, the principal business artery of the city, and extends two and a half miles to a point beyond the easterly city limits.

The important section of the channel from a construction point of view, however, is a mile in length, with Union Avenue near the center. In this section nearly one million cubic yards of excavation was required. East and west of this section the new waterway cuts through wide bottom lands and consists of a low-water channel with levees for confining the flood waters.



BARRIER OPENING TO PASS RIVER

A section of Rock Canyon Barrier, built six miles up the valley above the City of Pueblo, to hold back the crest of the floods. The gap in the concrete wall permits passage of the river

Heavy cutting into the bluffs as well as a cut of 15 feet below the valley floor was necessary in the construction of this central section of the channel, which has an average bottom width of 177 feet and slopes of 1½ to 1. The bluffs form a natural bank on the south side, but on the north bank the cut below the valley floor is supplemented by a levee for completing the channel to the required depth. Channel and levee slopes are continuous and are paved with reinforced concrete.

Before the channel could be constructed, it was necessary to remove a railroad terminal containing 34 miles of track and to construct a new terminal, with main-line connections to the west. The channel is spanned by one railroad bridge and four street bridges.

Rock Canyon, where the barrier is located, is six miles upstream from Pueblo, and here the principal arteries of the drainage basin converge to the river. With the exception of Dry Creek, which comes in from the north near the westerly city limits, only local drainage from six square miles of territory enters the river between Pueblo and the barrier. This is therefore the logical place for checking the larger floods. It is also the natural site for the barrier, because of a flat ridge of sandstone that extends across the valley at an elevation of from 17 to 20 feet above the river bed. With this situation the barrier was half built before construction started.

The barrier is composed of two sections, divided by a double-track railroad line that parallels the river on the south side of the valley. Extending south from a concrete retaining wall at the tracks to high ground at the south side of the valley is the earth section, an embankment 1,540 feet long, 20 feet wide on top, and 35 feet high at the highest point.

North of the tracks is the concrete spillway, which, with one break, extends 1,513 feet to the bluffs on the north side of the valley. In this way an open-top gap 31 feet wide is provided for the tracks.

The spillway is a mass concrete dam 28 feet high with its crest curved transversely. It is designed to be overtopped by a flood. This is not the case with the embankment, the top of which is placed 13 feet higher than the spillway where it is well above any danger of overflow. Where the spillway crosses the river there is an open-top gap 41 feet wide. In addition to the above the barrier is pierced by two minor openings.

In determining the normal capacity of the channel through the city, 100,000 second-feet was allowed for the discharge from the barrier and 25,000 second-feet for a simultaneous flood from Dry Creek.

Checking the Onset of the Flood

If a flood ever reaches the crest of the spillway, the total discharge from all openings will be 100,000 second-feet, with 18,000 acre feet of water backed up in the basin behind the barrier. For this a flood having a peak flow of 145,000 second-feet would be required. It would take 15 hours to fill the basin to the crest of the spillway, while the crest of the flood would pass three and a quarter hours before this stage could be reached. The possibility that a flood will ever overtop the spillway is therefore remote.

Dry Creek has a drainage area of 86 square miles. During the greater part of the year it is a dry wash, but in the flood season it is subject to cloudbursts of the greatest intensity. A few hours before the 1921 flood in the Arkansas this stream sent down a peak flow of 28,000 second-feet.

Four railroad tracks, built in connection with the flood-control work, cross Dry Creek half a mile from its junction with the river. These tracks are below high water level. The bridge at this point is of unusual construction, since it is designed to serve as a railroad bridge, as a means of protecting the tracks against overflow, and in some measure as a barrier for checking floods.

This structure is a reinforced-concrete, girder bridge consisting of five 40-foot spans. The downstream and intermediate girders are each nine feet six inches high, while the upstream girder is twelve feet six inches high. This construction not only eliminates the expense of raising the tracks to a line above high water level, but provides for an additional three feet of heading up on the upstream side, with consequent checking of the largest floods. Protection at this point is completed by levees connecting with the abutments.

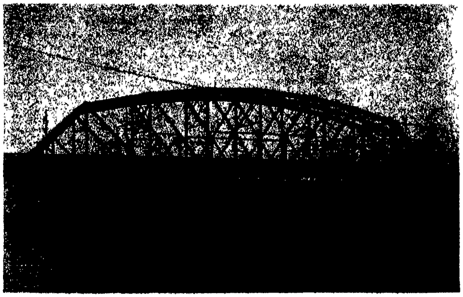
BUILDING THE SPILLWAY

Rock Canyon Spillway extends 1,513 feet from the river to high ground. A massive earth embankment, 1,540 feet long, reaches to the opposite side of the valley. Excessive floods may pass over the spillway

In the matter of floods, Pueblo is peculiarly situated. The shape of the front range of the Rockies is such that much of the drainage basin lies in a triangular mountain pocket which is 60 miles wide on its eastern and open side and which runs to a point at Canon City, where the Arkansas comes out of the mountains. Storm clouds from the east are sometimes driven and piled in dense masses into this pocket. Whenever this process continues long enough the result is a series of cloudbursts.

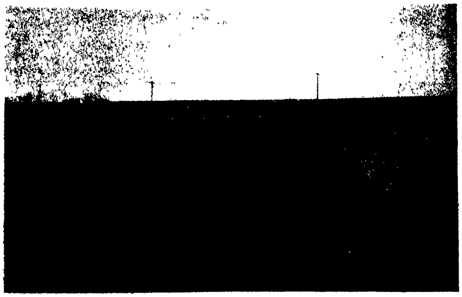
Owing to the intensity of the rainfall and the steep slopes of the country the resulting flood, although usually of short duration, is destructive because of its high peak flow. All these conditions were present in the flood of 1921.

By their mutual action the various control structures will protect the city against a flood with a peak flow 80 percent greater than that of 1921 and two and a half times as great as that flood in volume. After a careful study of the flood possibilities of the drainage basin, this amount of protection was determined upon as ample, but not excessive.



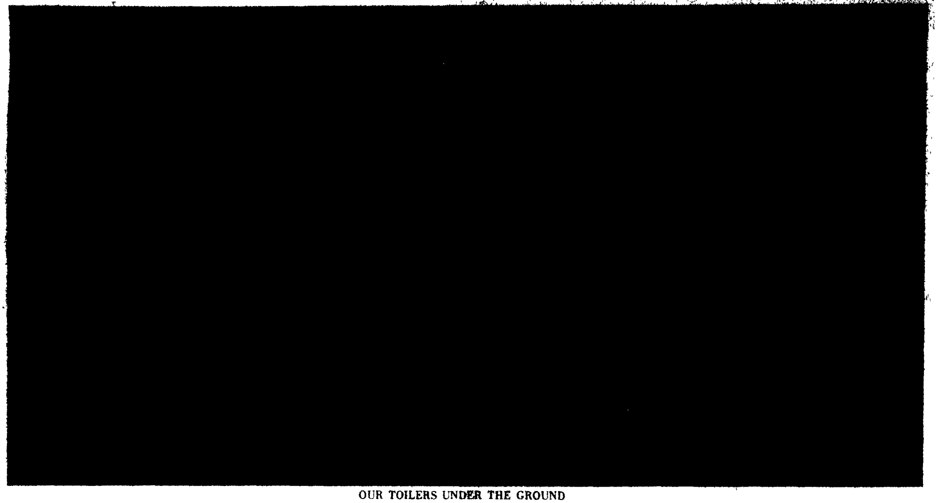
STEEL BRIDGE OVER NEW CHANNEL

Santa Fe Avenue Bridge over the new channel of the Arkansas, with railroad bridge beyond. The channel is capable of carrying a flood one and one-half times as big as that of 1921



CONCRETE RAILROAD BRIDGE

The bridge built to carry railroad tracks over Dry Creek (see upper left hand of map). It serves also as an effective barrier to hold back the crest of heavy floods



OUR TOILERS UNDER THE GROUND

Some of the two hundred mine workers who gather during their noon-hour in the underground "movie palace"

An Underground Moving Picture Theatre

A Novel Method of Providing Entertainment and Instruction for Miners and Their Families

By James H. Collins

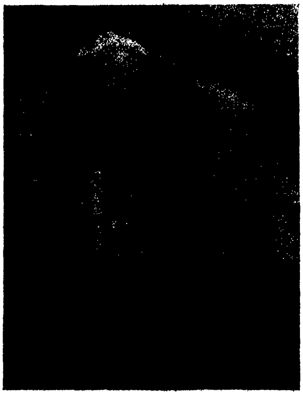
THIS theatre has no thrilling posters in the lobby, no beautiful marcelled blonde in the box office, no tabloid opera, vaudeville, ushers, upholstered seats or orchestra—although two men in the audience did volunteer music when the theatre was opened some months ago, and furnished an overture on their accordions.

Yet this movie house does a profitable business, and probably puts on the "deepest" show in the world, being 250 feet underground, on the second level of the Spruce Iron Mine, at Eveleth, Minnesota. It has a seating capacity of 200, and it puts on regular noon-hour shows about every other week.

Safety-first Methods Taught

Several years ago, the Oliver Iron Mining Company began showing accident-prevention films to its employees, who are scattered over miles of country. Here they work underground, there on the surface, and in other places mining is done by the open pit method. All sorts of schemes were devised to make the exhibitions attractive and convenient to employees. Pretty nearly every nook and corner where a projecting machine and a screen could be set up was used as an improvised theatre. Sometimes the audience was assembled in an eating house, sometimes in one of the "change houses" where the men wash up after coming above ground, and sometimes in a garage, machine shop or wherever it was dark enough to give the show, and employees could sit down on improvised seats. The "safety first" movie flitted around like a will-o'-the-wisp, here today, gone tomorrow, like the circus. But, wherever it went, it was popular with the miners and their families.

At the Spruce Mine, there was an abandoned room formerly used for a pumping station. The miners suggested turning this space into a theatre so that the pictures could be seen during their lunch hour without the necessity of going above ground. The room was fitted with rough benches, projecting machines, silver screen, electric lights, and ice water; and immediately it began drawing the biggest possible audiences, because everybody working in those diggings attended the movie show.



THE "WILSONIAN AUDITORIUM"

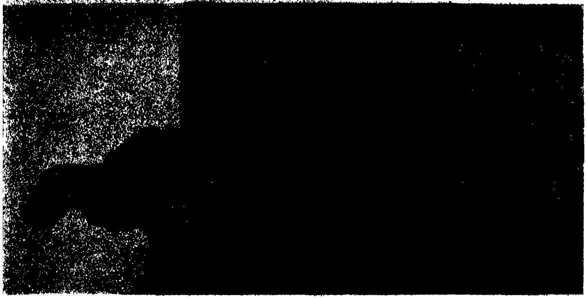
This small theatre is equipped with rough benches, projecting machines, silver screen, electric lights and even ice water

Pictures are shown at noon, and the company goes fifty-fifty on the time needed to see them—that is, the company contributes so many minutes of working time for which the men are paid, and the men contribute an equal number from their lunch time. The "movie palace" is known as the "Wilsonian Auditorium." Its manager is Charles Grabowsky, general superintendent of the mine, and the actual program and projection are in charge of Walter Ethier. The programs are short, generally two reels. In case the picture happens to run that length, it makes the whole show. But if there is only one reel, a comedy or educational reel is added.

Lessons for Future Miners

The show is repeated at other mines, and also at places on the surface where employees' families can see it. In this way the youngsters learn safety mining methods early in life. Both below and above ground, the program is made up to entertain as well as teach. No matter how attractively it may be dramatized, a safety lesson in picture form is none the less a lesson. On that account, extra reels of pure entertainment are added, and frequently they are comedy reels.

The novelty, convenience and interest of this picture theatre have been a factor in reducing accidents and safeguarding property.



Two gargoyles in place on the wall

Fossils in Architecture

A new note in architecture is marked by the decorations attached to the geological building recently completed at Washington University, St. Louis, as illustrated on this page. Under the direction of Professor Walter E. McCourt, head of the Department of Geology at that University, the familiar designs of devils and mythological beasts commonly used for decorative gargoyles have been replaced by sculptured reproductions of some of the ancient beasts which really lived on earth in remote geologic times. Thus artistic fitness and geologic interest are alike attained; and surely, from a standpoint of grotesqueness, these extinct creatures leave nothing to be desired.

An ancient flying reptile, or pterodactyle

Phorohacos, an extinct giant bird of Patagonia

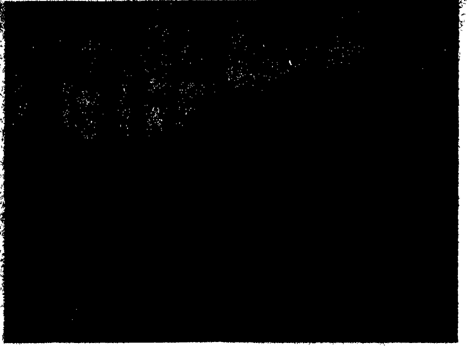
The Megatherium, one of the giant extinct sloths

Below, to the left, is the Stegosaurus, one of the great armored dinosaurs common during the Age of Reptiles. Below, at the right, is the Tylosaurus, a fish-like reptile which once swam in the ancient seas. Above are the models of the pterodactyle and the Ceratosaurus, as they are attached to the building

The Ceratosaurus, a horned, flesh eating dinosaur

MOLLY COTTONTAIL TURNS TO THE BRIAR PATCH

Here she will scrape off the attacking weasel. Seldom are powerful, fleet-footed and alert rabbits overcome by the bloodthirsty little killers



THE PEKAN AND THE BAY LYNX OBSERVE FOREST ETIQUETTE

The lynx's possession of his prey is respected by the equally powerful pekan. Had the pekan first made the capture the lynx would have retired

Nature Faking

Popular Fallacies Have Grown Out of Pseudo-Scientific Nature Lore

By S. F. Aaron

Drawings by the Author

WHEN the late Theodore Roosevelt directed a well-aimed and perfectly logical blow at "nature faking," he rendered to popular natural science one of the most distinct services. But this sort of warfare must be continued; for the nature fakers still exist in growing numbers. The Colonel's attack upon an ill-informed writer of many books, who has since spread himself even more disastrously, is now a matter of history; it is admittedly a well-set example for popular scientists and nature students who possess a genuine interest in educational advancement.

Sensationalism seems to be so much the order and practice of the day in literature that, notwithstanding the extension of scientific research, there are some who give the impression of trying to emulate Baron Munchausen in his extravagant tales.

Scientists and Naturalists to Blame

There always has been and probably there always will be that very human tendency toward imagination which is one of the characteristics that lift the human species into civilization and drop it into error. Even scientists fall victims to it in their eagerness to erect hypotheses; and they almost unknowingly broadcast it in minor things. The trained naturalists are most to blame, since they are seekers after truth and find nature sufficiently wonderful and expressive to forbid supposition or make-believe.

Burroughs did much in his day to upset the false ideas of the *literati* respecting simple facts in natural history. He discovered vast errors in the work of the poets, and even assailed Thoreau, from whom one would hardly have expected error, since it was he who claimed that he "could tell the hour and the day of the month by the appearance of certain plants." Such a claim is about as fancifully absurd as any exaggeration could be, when one considers that as much as two weeks may pass between the sprouting and blossoming of any species, and that there is much difference in the unfolding or closing of flowers on sunshiny and on murky days.

But Burroughs himself, through faulty observation and almost blamelessly, drifted into palpable errors.

The author of "Birds and Seasons" showed marked disapproval of the less exuberant fakers of the last generation. Hamilton Gibson threw several bricks into the camps of those who expressed a growing tendency to tell what they did not know, and himself became involved in several statements, especially one regarding the bagpipes of tree frogs and toads, which he pictured not merely as swellings in their throats but as great membranous bubbles extending out of their mouths.

Even the great Fabre, who has been more lauded and quoted than any other nature writer of a foreign country, could not refrain from errors due to supposition and incomplete observation, one of which—namely, the intended puncture of the central ganglia of spiders by the captor wasp for the purpose of paralyzing—has been shown to be a fallacy.

DIGGER WASP AND JUMPING SPIDER

Wherever the sting is given the spider instantly succumbs. There is no need of reaching the central nerve ganglion

These cases, however, in which the carefully investigating naturalists are remiss, come from closely related facts and are not born entirely of the desire to relate wonders and unheard-of things. It is the writers of books designed to be "best sellers" and the contributors to periodicals that prefer high-sounding phrases and startling episodes who force upon unsuspecting readers lamentably absurd errors, regarding the habits and habitats of animals.

A Perusal of Text-books Would Help

Thus, we read (and to this I have before demanded attention, though it cannot be too often driven home) of tigers being hunted in Africa, and of jaguars and boa-constrictors blundering around Asia and Africa. Any child who can remember a little of his geography lessons should know better than this; and is it not strange that the caterers to public taste in print do not first peruse some simple text-books?

Thus, we are asked to go afield with an admirer of butterflies, who at least deserves a reading because he has seen in the wings of the Lepidoptera, beauty that rivals gems and flowers. But, unfortunately, in one blossoming meadow he finds a dozen species that inhabit only very widely separated areas over our broad land. So, we must suspect him of being guilty of letting loose an assortment of the insects from every point of the compass before he begins to note them!

Not content with such errors as the foregoing, the emulators of certain naturalists who, to begin with, were deplorably given to relating unsubstantiated and unnatural things, have, with as little reason and learning as is shown in their ignorance of geographic distribution, most ridiculously allotted to some of our commonest and better known creatures behavior that one might expect from animals endowed with human intelligence and almost unlimited strength.

And so we read of a puma, with uncanny precision, leaping out and down thirty feet upon an unsuspecting deer and breaking "nearly every bone in its body"—the deer's body, of course. Some jar that! Being hit with an express train would hardly match it. We read of a python striking and killing a boy with a blow of its tail. Such an incident, unless the lad were scared to death, could happen no more easily than he could be killed by being hit with a sack of oats. We read of a sheep-killing dog that raised a window to get out on a night hunt and, returning, shut the window after him, a thing which no dog, however intelligent, has the brains to do. It simply is not within his understanding.

We read of a weasel in the ermine's coat of the "white assassin" seizing a grouse under its beating wing, one blow of which, in reality, would send the weasel topsy-turvy; of his chasing rabbits, with the foregone conclusion that Bunny is as good as dead if he persists; of his going down a tree, across to and up another in the same time during which a red squirrel would leap from one branch to another; of his forcing the squirrel to the ground and then catching it. All of this is entirely fanciful.

This sort of thing, however, may in a measure be excused, if the author has perused "Wild Animals of North America," published by the National Geographic Society, in which the statement is made that rabbits fall an easy prey to weasels. Such is not the case. Molly Cottontail can as easily outrun a weasel as a greyhound can distance a dachshund; and she is too strong to be easily held.

Some Myths Exploded

There are on record cases of rabbits being seized in "the squat" by the stalking weasel and then breaking away. I have witnessed two such instances. In one case a rabbit more than half grown had been cornered in a woodchuck hole by a large stoat. By prodigious leaps, dashes through briars and final kicks, the stoat was shaken loose; and instantly, knowing the futility of pursuit, it gave up the chase. Moreover, weasels cannot overtake red squirrels on the ground. I have seen several such pursuits, one leading along fences, through piles of brush and over logs. Neither animal gained an inch until the squirrel went up a tree; and then the weasel was hopelessly left behind and went off on other business.

The impression has also been conveyed to the uninitiated that rabbits are frightened into a comparative state of helplessness by the mere approach of a weasel, as though the weasel possessed some sort of hypnotic power. This is also suggested in a book and in several other references by a well-known and popular naturalist. There is no more truth in this assumption than in the traditional notion of snakes charming birds and small quadrupeds.

Burroughs' story of the red squirrel that went into a tree and then left it to go into rocks, followed presently by a weasel is, to my mind, not worthy of belief. He got it from another and should not have been so credulous as to quote it. In the experience of every naturalist, hearsay evidence too often proves unsound; like some fish stories, such statements are not untruths, but exaggerations or mistaken impressions. Often, too, they are direct untruths. If one would write a natural history based only on hearsay, Dean Swift or Verne would be outdone.

Burroughs also seems to half credit yarns of birds being charmed by snakes, though asserting that "there is probably little truth in the popular notion." There is, indeed, so little truth as to make it appear almost unworthy of denial. Yet these notions have become traditional, either as merely related incidents or as pointing a moral. But in every case they result from imperfect observation, exaggeration, or both. In every instance, the supposedly charmed creature is wrought with fear for its young and itself or its mate and is struggling with indecision as to whether to attack or retreat from an insidious foe. It seems altogether impossible to credit the idea of the near-victim's becoming faint or comatose when rescued.

In the case of the partridge and snake, as told to Burroughs, the bird was merely incapable of sustained flight and sank down after the ordeal from mere exhaustion. Burroughs' own experiences are quite different; witnessed by such a competent observer, no evidence of hypnotic power is seen. Indeed, as with the rabbit and weasel, nature has not developed fear to the extent of endangering her creatures, but to give them greater powers of self-protection. Otherwise, all the rabbits would quickly fall victims to weasels and all the birds, to snakes.

I have many times placed sparrows and mice, and once a chipmunk, in cages with snakes, to test this "charming" story. There was opportunity for the supposed victims and the victimizers to approach or retreat. In no case was there even fear shown on the part of the former until the latter attempted to make a capture, which was always by means of the chase, or a sudden opportune strike. Quite often the birds and mice, in search of food, hopped upon the body of the snake, encountering its glaring eyes without so much as noticing them; and the birds easily avoided the snake's efforts to capture them. The chipmunk, when seized, bit the head of the black snake so severely as to effect escape and shortly to cause the death of the reptile.

SPARROWS FIGHT A SNAKE

This picture illustrates Burrough's account of such an incident. The birds easily keep out of the reptile's reach and valiantly attack it They are by no means charmed

I think it is seldom that well-grown rabbits, squirrels and adult birds are captured by snakes; nor is it quite possible to accept as good natural history the dead thrasher in the loose coils of the snake in Audubon's famous picture. I have seen both thrashers and mocking birds, a pair of each, without other aid very decidedly defeat black snakes, although evidently doing the snakes very little harm, and I have seen also a lone meadowlark kill a large garter snake that threatened her nest of young. Burroughs' description, from his own experience, of the song sparrows fighting a snake in defense of their young, is the most delightfully presented evidence of what actually occurs between snakes and birds in close contact

Yarns which are all too common and which are made much of by the sensation-mongers are those of fights to the death between wild animals upon every conceivable occasion. One very popular book, delightfully written with regard to its poetic sympathy with the wilds and the ancient forests, and other stories by the same author, make head-liners, as it were, of these acts, and it is a favorite theme with beginners in magazine nature-stuff.

After long experience, this statement of fact seems worthy of repetition. Aside from occasional battles over doubly claimed victims—which quarrels are settled very quickly—and the sometimes, though seldom, prolonged scraps of rival and amorous males, all mammals and birds recognize inferiors and superiors of their own or other species and attack or give way often without further parley. Moreover, there is among wild animals—feathered or furred—little of the bulldog or game-cock tenacity which has been bred into these domestic creatures by man. Nature demands at all times survival, and she seeks invariably the course of least resistance.

Emotions and Sentiments Exaggerated

Thus, as between species, bears quietly dominate all other creatures. Even the lordly moose and stag wapiti, when alone, acknowledge his superiority. On the other hand, Bruin does not encroach upon the moose or elk herds. Wildcats respect the pekan, and the latter keeps clear of the wildcat; the two species of lynx, where their habitats overlap, dodge each other with positive certainty, and it is the same way with the fox and the mink and all other creatures with regard to the otter. Even the puma is a diplomat—in many respects a coward. He shows the same caution toward other enemies—the lynx, pekan, otter and wolverine—as toward man and his dog.

The mountains, vales and prairies are so large that there is no necessity for fighting over a few yards of lair or a nesting place, and when a quarry is brought down there is, in nearly all mammals, a certain and very positive respect for the possessor. Birds do not show this so much; they are eager snatchers, quarreling, but seldom actually fighting, over the choicest morsels.

Perhaps the most common and really inexcusable errors that lend themselves very naturally to nature faking are those which combine with suppositions respecting animal intelligence They have had birth in Aesop's "Fables" or in "Reynard, the Fox"; in this day they have their biggest boost in certain very popular biographies. But, to the closely investigating nature student who may justly believe in animals thinking and reasoning within their experience and hereditary understanding, the idea that their sentiments and emotions are akin to those of man is in a serious sense distasteful.

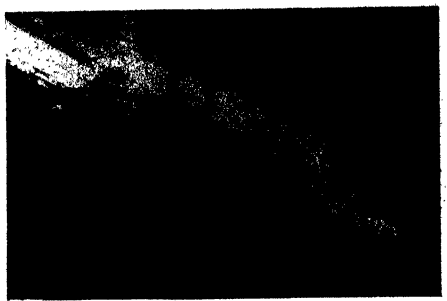
Aside from mother love, the mating instinct, which is carried far enough to show a degree of unselfishness in the male, and the gregarious instinct, which extends to the choice of a single companion—more rarely of another species—nothing of loving choice, sentimental consideration nor positive generosity is demonstrated by animals. The homing instinct is merely a desire to get back to familiar hunting and resting places; but the roving tendency often proves as strong, governed by the search for food or a mate, since these two urges are the dominant influences among all creatures, from the gnat to the elephant.

From the Scrap-book of Science—C mera Shots of Scientific Happenings

Wide World

REPTILE CAUGHT EVOLVING

The fossils of Seymouria, an extinct reptile of the Permian Period, 75,000,000 years ago. This highly significant fossil, which shows many characteristics of the amphibian from which it was evolving, is at the University of Chicago



Wide World

REMARKABLE CATERPILLAR RECENTLY FOUND IN BRAZIL

Do animals imitate Nature in order to camouflage themselves? This four-inch caterpillar found by George M. Dyott apparently shows that they do, for it closely resembles the plants on which it feeds. Zoologists disagree, however, about the question of natural camouflage. There is much to be said on both sides

Keystone

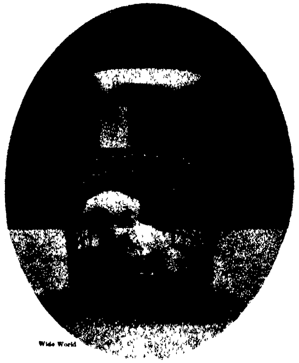
TESTING MOTOR CAR PARTS HE BUREAU OF STANDARDS

The United States Bureau of Standards, ed at Washington, D. C., is conducting extensive tests on various metals which r into the construction of motor cars. The Bureau is attempting to collect the s of all the testing laboratories, public and private, in the United State d would appreciate information

Keystone

THE EARTH'S MASS IS ABOUT 5,000,000,000,000,000,000,000 TONS

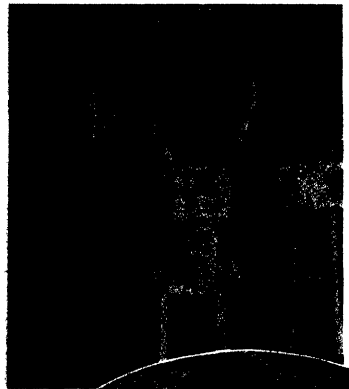
Dr. Paul S. Heyl, noted physicist of the United States Bureau of Standards, recently redetermined the mass of the earth. He is shown observing the delicate torsion balance employed (see Scientific American, Dec., 1925, page 392). Since temperature changes affect it, the observations are made through a telescope



Wide World

FIGHTING THE DOG'S WORST ENEMY

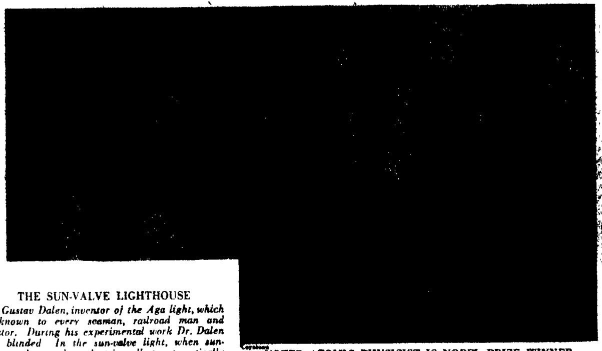
The minute germ of dog's distemper has remained invisible under the best microscope, but the new Barnard microscope may reveal it. Ultra-violet light alleviates this disease. The dog's eyes must be protected during treatment



Keystone

THE SUN-VALVE LIGHTHOUSE

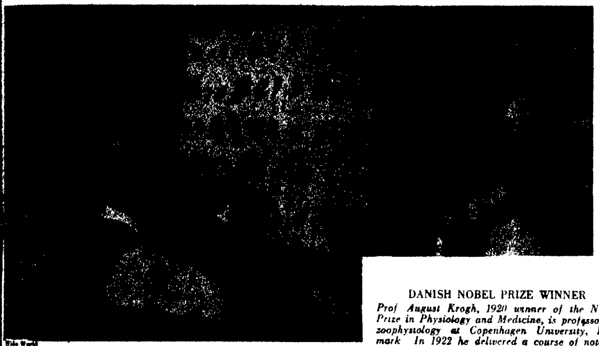
Dr. Gustav Dalen, inventor of the Aga light, which is known to every seaman, railroad man and aviator. During his experimental work Dr. Dalen was blinded. In the sun-valve light, when sunlight strikes a photo-electric cell it automatically connects a circuit and shuts off the lighthouse. When night comes, the circuit opens and the light automatically comes on again



Keystone

NOTED ATOMIC PHYSICIST IS NOBEL PRIZE WINNER

To study under Prof. Neils Bohr, the famous Danish physicist, scientists come from all over the world. Out of several competing theories of the inside of the atom, Bohr's theory has now been virtually accepted. Few young men have received so much deserved fame



Wide World

WHY THE LEAVES TURN RED

In summer, the leaves of trees absorb ninety percent of the sunlight; but in fall they shut most of it out. Growth is then retarded and the leaves ferment. Complicated alcohols form and absorb the green chlorophyl of the leaf. This brings out the red and yellow pigments

Keystone

DANISH NOBEL PRIZE WINNER

Prof. August Krogh, 1920 winner of the Nobel Prize in Physiology and Medicine, is professor of zoophysiology at Copenhagen University, Denmark. In 1922 he delivered a course of notable lectures at Yale University. Much of his life work has been in biochemistry, a science which many anticipate will finally solve that greatest of biological problems—what is life?

Pacific & Atlantic

RADIO PEN BROADCASTS PICTURES

C. Francis Jenkins, Washington radio inventor, has just completed an apparatus which sends maps or pictures through the ether. The receiver used works with any tube set, in place of the loudspeaker

Keystone

RENOVATING THE SPHINX

In order to offset the effects of time and the elements the Egyptian Government has been furbishing up the Sphinx. Parts of the head in danger of disintegrating were braced

Keystone

EXCAVATING ON MYSTERIOUS PACIFIC ISLAND

In Saipan, one of the Mariana Islands, Prof. Herbert E. Gregory of Yale, has unearthed evidence that its former inhabitants were related to an ancient population of northern Japan

Keystone

DEVICE MEASURES TEMPERATURE ON MARS

Dr. W. W. Coblentz, of the United States Bureau of Standards, with the electric thermocouple by means of which he found the temperature on Mars to be like that of a cool day on earth

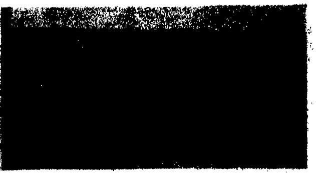
Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

Loading a heavy case without crane or tackle

When the truck moves away, the barrel is hoisted



The loading device swings out of the way

A French Truck-loading Device

TO overcome the difficulty of loading motor-trucks with heavy objects when no cranes or tackle are available, is the object of an apparatus perfected by a French inventor, M. Biblis of Bayonne, France. This device consists of a metal platform to which, at right angles, is attached another open curved platform. Along each side of the latter are attached large treads. The apparatus is attached to the chassis of the truck by an axle joint. There is also another movable joint in the arms of the apparatus a short distance from the truck.

The operation is exceedingly simple. The object to be loaded is placed on the platform as it rests on the ground. Then the truck moves away, and the apparatus held back by the treads raises the load. When the apparatus reaches its highest point, a slightly inclined plane is formed to the floor of the truck and the load moves onto the truck by virtue of its own weight. If the object is rectangular, a wooden platform is inserted between it and the apparatus so that it will slide on more easily.

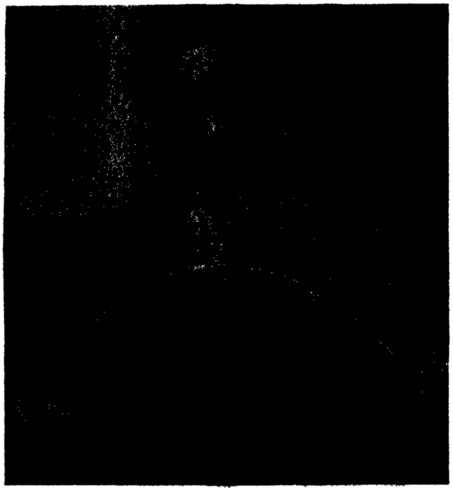
Indicating the jointed spout

New Oil Can Spout

A NEW idea in spouts is embodied in an oiler that has recently been put on the market. About an inch from the fount is a joint in the spout, which enables the user to bend it at any angle necessary and still deliver a full stream of oil. Its greatest utility is in oiling parts that are not accessible to the common oiler, which must be nearly vertical to give a full amount of oil. A number of different sizes are available.

A Glass Substitute That Can Be Bent

MR. J. C. VREDENBURG, of England, and Dr. Fritz Pollak, of Vienna, have succeeded in inventing a glass substitute that will bend. Real glass, made of minerals, breaks very easily. The new glass substitute is made of organic materials and is as transparent as ordinary glass. It can be bent and shaped. It breaks, but it has no sharp edges. Flames will not burn it; and it bounces higher than the ordinary golf ball when it is thrown down. It may be colored with the most delicate vegetable dyes. It could be used to great advantage in the making of windshields for automobiles, instead of glass which, in breaking, is responsible for the deaths of many people in automobile accidents. Mr. Vredenburg is shown demonstrating the bending qualities of the new glass substitute.



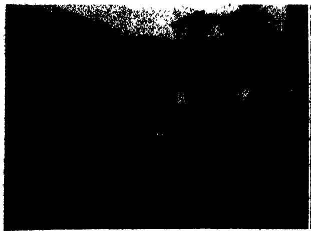
This glass substitute can be bent but it does not break

A Chain Saw for Lumbering

A SHORT time ago we published a photograph of two men sawing down a large tree; and at that time we called attention to the fact that the work of tree-cutting seemed to offer a field for invention. As a result we received two lots of photographs, showing two distinct methods of tree felling—one operated manually and one by power. We have already published the former.

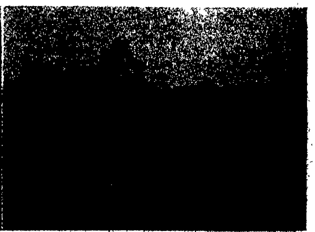
Difficult oiling becomes easy

The power for the chain-saw shown in these photographs is derived from an engine by means of a shaft. The saw offers a rigid front to the tree, pressing the cutting surfaces in rotation; but it is thoroughly flexible in the reverse direction.



A chain saw that cuts down trees

A chain saw as a cross-cut saw



Some of the sections cut by the chain saw

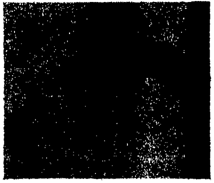
A glare shield and rear-view mirror

A Transparent Mirror

THIS device is a transparent mirror which serves a double purpose. It not only gives protection from glare, but it is also a perfect rear-view mirror. Oncoming glaring headlights are not hidden, but the glare is completely eliminated. The driver does not look through the mirror continuously, but keeps it between the glaring lights and his eyes. As he drives he looks to the right of it This arrangement makes driving against the dazzling sunlight also much more agreeable. When not in use it is swung up out of the way.

Dress Hanger Prevents Falling of Delicate Garments

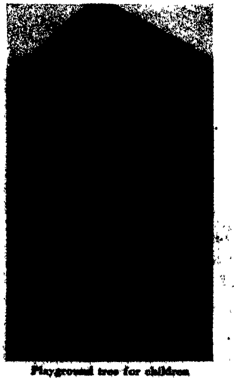
THIN dresses and negligees are likely to slip from the ordinary garment hanger to the floor. This is prevented in a recently patented hanger shown in our illustration. Arms of nickeled-steel wire, padded with felt, clamp the dress securely to the hanger until it is released by the lifting of the springs.



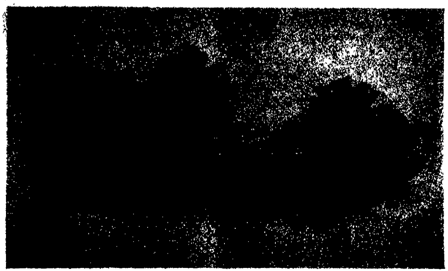
Dress hanger for thin dresses

A Safe Addition to the Playground

ALL children like to climb; and in municipal playgrounds climbing equipment is often very elaborate. Of more modest proportions is the device shown which could grace almost any children's playground, no matter how small. It is made entirely of pipe so there are no projections to tear the hands or clothing. Many schools have provided one of these "pipe trees," and they answer the purpose admirably. They are unbreakable and will last a long time.



Playground tree for children



There are twenty-four one-inch drills in each head

Detail of horizontal multiple-drilling machine

The Mechanic Under the Auto

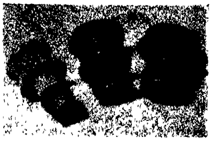
AN automobile is apt to have trouble in its inaccessible underworks at the wrong time, and the professional or amateur mechanic may be often seen ingloriously recumbent under the machine. Now a clever inventor has devised what he calls a "creeper." It is a platform on casters which lifts the person off the ground. The one shown has a headrest giving three positions

A creeper which makes getting underneath an automobile simple

A Curious Looking Machine Tool

THIS machine is known as a horizontal multiple-drilling machine. The machine, as illustrated in the photograph, has a capacity of 24 one-inch drills in each head, so that at one setting 48 one-inch holes can be drilled through cast iron at the rate of three inches per minute. The weight of the machine is approximately 18 tons; and it is driven by two 27 horsepower variable speed motors, attached directly to each head The heads are equipped with fast approach and return and are electrically controlled.

A machine of this type is particularly adapted to the drilling of pipe fittings and in kindred industries and can be used to great advantage in locomotive shops. It is the largest machine of its type ever built.



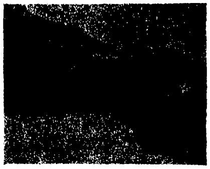
Expanding bottle stoppers

Save the Fizz!

NOTHING is more exasperating, upon opening a bottle of liquid which should effervesce, than to find that the gas has seeped out through the cork or under the crown seal With the stoppers shown, a turn of the hand expands the rubber band so that the gas is prevented from escaping around the edges

A Clean-cut Can Opener

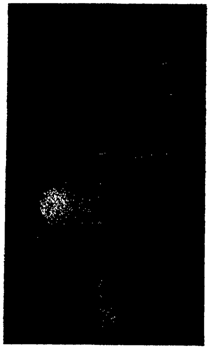
THIS can opener is equipped with a pair of cutting wheels in lieu of the usual opening blade The wheels make a perfectly clean cut in removing the cover of a can. The cover works on the same principle that is employed for shearing metal in factories where large quantities of metal must be cut perfectly Either of the two cutting wheels may be used by reversing the cutter.



A can opener making a clean cut

Doing Away with the Old-time Wash Tub

HERE is a new wrinkle for the laundry. The laundry tub is made of aluminum and revolves. The saving of labor and time is obvious As each operation is completed, the tub is revolved to allow of rinsing, et cetera Hot and cold water are supplied by a rotating spigot.



Novel revolving laundry tub

An earnest young author

Another position for the work desk

A Useful Toy

OUR two photographs show a play work desk which encourages children to write or draw. Beneath the drawing board is a box for paper, pencils, crayons, et cetera. Books rest on the desk at the correct angle for reading. It cannot tip over because of the spread of the legs.

Golf Strokes for the Screen

Taking pictures of a golf drive through a glass plate. The resulting pictures have been shown all over the United States

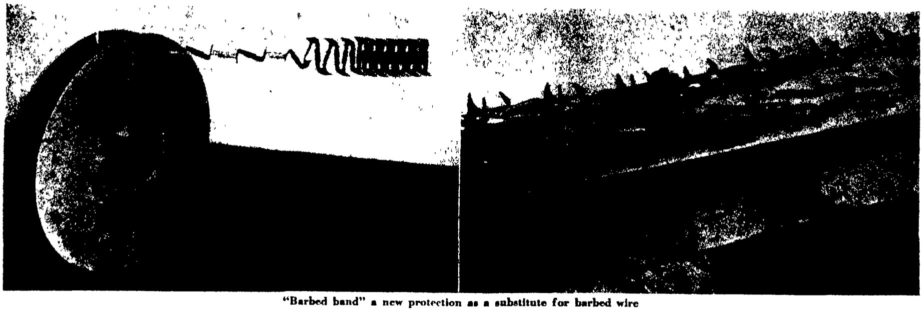
A FAMOUS golf player is shown driving from a piece of plate glass three-quarters of an inch thick, attached to a frame seven feet from the ground. The camera can be seen under the glass, focused directly up at the golf player. Ultra rapid movies were made by this method.

Barbed Band

THE "barbed band" shown in our two photographs consists of strong hoop-iron, punched on both sides, so that a small barbed band can easily be stretched. The punching is done in such a manner that the barbs protrude in small spaces. Inasmuch as the stretching is done at the place where it is used, one need carry only a small ring of the punched band, showing no barbs.

A Tructor for Handling Tin Plates

THE motions of this new battery-operated "tructor" resemble those of a man doing similar work. The steel forks or forearms are thrust beneath the load. The truck picks up 4,000 pounds of greasy tin sheets.



"Barbed band" a new protection as a substitute for barbed wire

Tin-plate handling unit operated by a battery tructor carries the sheets to the machines or deposits them on a pile

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Lost Flower Is Found Again

A SPECIES of flower which was discovered about the year 1750 and then lost for 175 years has been independently rediscovered by two scientists, Dr. E. T. Wherry of the United States Bureau of Chemistry and Dr. J. E. Benedict of the United States Museum. This rare flower is known as the pink turtlehead. It was found near Marlboro, Maryland.

The pink turtlehead grows in wet ground, reaches a height of about three feet and has pink flowers resembling the neck of a turtle. Dr. Wherry states that this rare plant was collected by John Clayton, a noted Anglo-American botanist in the middle of the 18th Century and was sent by him to Linnaeus, in Sweden. Linnaeus named it *Chelone obliqua* and it is so listed in the botanical manuals. Here, however, the species described refers to a plant which may or may not be of the same species, and which comes from a wholly different region from that in which Clayton is known to have collected, namely, Illinois and the neighboring states. As Clayton did all his collecting on the Coastal Plain in eastern Virginia, botanists have for some time been hoping that this plant might be rediscovered in that region.

Possibly some of our readers will be able to locate it elsewhere.

The pink turtlehead. Perhaps some of our readers have discovered this rare flower

* * *

Portable Mine Piping

To provide fresh air for mine headings, a flexible tubing which has an efficient air delivery range of one-half mile from the fan, has been tested by the Bureau of Mines and is giving satisfaction in both metal and coal mines.

This tubing is made of a heavy fabric thoroughly impregnated with fungus-and-acid-resisting compounds. It is light in weight—one man can *readily* carry 200 feet, as our illustration shows, and it can be quickly installed—one man in a timbered tunnel can put up over 400 feet in two hours.

A messenger wire is strung on pegs or posts 20 feet apart. Each section has grommet holes in the seam, spaced 18 inches apart, and suspension hooks on the wire engage these holes. The sections, each ten feet in length, have rings on either end. These rings are covered with the fabric. They can be slightly compressed in diameter so that one will fit inside and beyond the other, thus forming an overlapping joint which becomes tight as the air pressure is increased. Where it is desired to clear the heading in a mine when the shots are very heavy, a special section or blasting piece is fitted with snap hooks and when in delivery position this is coupled to the main line. Just before firing the blast, this section is unsnapped and is run back out of danger on a parallel side line. Any damage to the tubing at any time can be as readily repaired as an automobile tire.

* * *

The Truth and Some Hokum About Melting Out Ice Jams

INACCURATE, unscientific newspaper accounts of the efforts of Prof. Howard T. Barnes of McGill University, Montreal, to move an immense jam which was threatening early in March to wipe out Franklin and Oil City, Pennsylvania, had the effect of misinforming a large section of the public concerning the nature and use of the well known substance known as "thermit" which was being used for that purpose. Some of the papers stated that thermit, which generates a temperature of 5,000 degrees, Fahrenheit, was invented by Professor Barnes for the purpose of melting the immense jam of ice in the Allegheny River. Neither statement is correct.

By the time this account, written March 17th, reaches the reader, the two thriving Pennsylvania communities will probably have been delivered from the threat of an unprecedented accumulation of river ice, or else largely devastated by that same ice.

The repeated statement in the press that Professor Barnes, a professor of physics, was *actually trying to melt the river ice* created such extreme doubt in the mind of the writer that Professor Barnes was requested by mail to state the true facts. Not only some newspapers, but certain magazines have persistently created the false impression that it is feasible to get rid of snow or ice by melting it. Any schoolboy who has studied elementary physics, knows, however, that the amount of heat energy required to melt an appreciable quantity of ice or snow is so great that all such attempts, whether they involve the use of hot furnaces, heated snow rollers or heated electric wires, are foredoomed to utter economic failure. Yet, this perennial notion of the impractical inventor and of the ignorant or unconscionable writer of pseudo-scientific feature stories will not down. This is what Professor Barnes writes:

> Oil City, Pa. March 14, 1926
>
> Your letter of the 11th relative to thermit in ice, has just reached me here. I have developed as a result of thirty years' experience with ice research on the St. Lawrence River new and powerful methods for ice fighting. The use of "thermit," which is the old stand-by of the Goldsmith patents, has enabled me to cope successfully with large ice packs in the St. Lawrence, and I have come out here for the purpose of helping these people at their urgent call for help out of a dangerous situation. Thermit is merely a tool in my hands which does very wonderful work in relieving ice accumulations. The theory of its use and effectiveness in ice is very difficult to make clear in a brief letter, but it is based on sound physical principles and is no experiment.

However the possibilities of its greater development are becoming more important and convincing since I first commenced to use it during last winter in taking out the large ice jams at Waddington, New York, and below Ogdensburg, New York, where we moved a million tons of ice in nine hours.

I have been very conservative in developing these methods and, although I successfully used thermit heat treatment last winter and during the present winter at the Cedar Rapids power development, I have carefully avoided publicity.

It has been in my mind several times to send you a scientific article with my own photographs of the new method. Yet no idea of the magnitude of the possible effects can be conveyed through a photograph.

Remember that the thermit is only a means of making the ice explode, and in itself is harmless and safe to use and transport. Dynamite and thermit cannot be compared because their action and function are so entirely different. The slow heave of an explosion, set up in the ice by the intense heat of thermit, is ideal for cracking and weakening the ice over a wide area. I have set up a crack over 600 feet long in 27 inches of hard, blue, uniform ice.

The high temperature of thermit radiates out its energy in a short wavelength that penetrates this ice and water a long distance before becoming entirely absorbed, thereby *loosening the binding* force between the crystals of ice in the same way that the sun's rays honeycomb the ice.

The whole thing is so new and interesting that much confusion exists in the mind of the public as to what I am trying to do. For example, many engineers and chemists ridicule me because they think I am trying to melt the ice. This is of course absurd. It is, however, a wonderful sight to watch the ice burning, due to the generation and oxidation of monatomic hydrogen.

Please understand my object in coming here. I want to do everything humanly possible to save these people from a greater disaster than they realize. I am using every known method of ice fighting. I have an organization here, military in its general scope, and I am

Flexible, temporary tubing of fabric is used in many mines for supplying air

Pacific and Atlantic

Breaking up an ice jam with thermit, which produces a slow, powerful heave

carrying on a campaign against a powerful and relentless enemy entrenched before the walls of these two cities. I have a dozen committees at work reporting to me every night.

This whole situation is a great physical research and I am applying the laws of physics on a big scale in the open instead of in the laboratory.

Pardon my long letter, but I very much value your sympathy and need your moral support, as I am working out these methods of ice engineering entirely alone.

Yours sincerely,
Howard T. Barnes

Discovering by accident that Professor Barnes was temporarily in New York the writer obtained an explanation of his work from him direct. Thermit is composed of aluminum mixed with iron oxide $(F_3 O_4)$. It has been used for years whenever it was desired to obtain great heat. For example, it is used for welding broken castings. It is a trade product. Its name is not "thermite," a spelling recently given wide currency by reporters who must have been influenced by an imagined analogy with "dynamite."

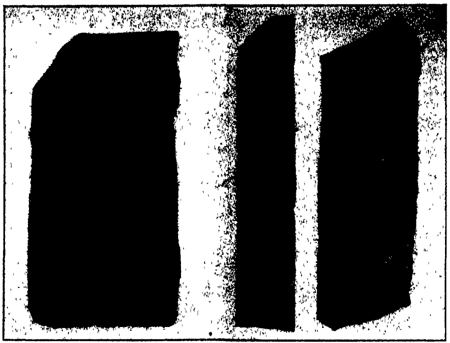
Smithsonian Institution

This slab of sandstone, 8 by 25 feet, is located 950 feet below the rim of Grand Canyon. Stone steps were built beside it

This mixture of aluminum and iron oxide is not explosive. It can be ignited only at 2,800 degrees, Fahrenheit, or higher. At that point, a chemical reaction starts. The aluminum combines with the oxygen in the iron oxide, forming an oxide of aluminum. A temperature of 5,000 degrees, Fahrenheit, is obtained in a few seconds.

What Professor Barnes does is to confine amounts of thermit, ranging from 10 to 250 pounds, in a metal container. He places this in the ice and detonates it with a dynamite squib. A wave of heat rushes out in all directions. The temperature gradient between the 5,000 degrees of the reaction and the 32 degrees, or lower, of the ice is so steep that this wave of short heat waves and visible light rays is radiated out several feet. This heat is absorbed by the boundaries of the ice crystals. It weakens but does not appreciably melt the crystals themselves. It loosens them just as the sun's light does.

A second effect, which was unanticipated, is explosive. The intense heat of the reaction breaks down the hydrogen and oxygen molecules of the ice without melting them. They pass directly into gas. Monatomic hydrogen is formed. This burns, producing flame. This dissociation releases an immense volume of gas which acts like an explosive of a slow type. Thermit thus acts much like black powder, giving a slow heave that breaks up the ice over a considerable area. That heave may be seen in the photograph.



Smithsonian Institution

Three slabs of sandstone removed from Grand Canyon. They show excellent footprints of animals whose actual fossils have not yet been discovered

Fossil Footprints from the Grand Canyon

TRACKS of extinct animals, at least 25,000,000 years old, have been discovered in the Grand Canyon of the Colorado River and are so remarkably well preserved that they have been prepared as a permanent exhibit on the Hermit Trail in the Canyon, to teach a lesson as to the great antiquity of the animal life that once roamed over these ancient sands millions of years before the Colorado River had excavated the deep canyon in which it now flows.

These tracks are fully described in a booklet issued by the Smithsonian Institution (Washington, D. C.), entitled 'Fossil Footprints from the Grand Canyon,' by Dr. Charles W. Gilmore, Curator of Vertebrate Paleontology at the United States Museum. Since so many hoaxes concerning fossil footprints have been announced from the Rocky Mountain states within the past year or two it is interesting to obtain from the same region the description of a group of fossils which are genuine and which have been scientifically interpreted. The fossils of the Hermit Trail occur in a fine-grained sandstone of Permian age, the period after the Carboniferous or principal coal-forming period.

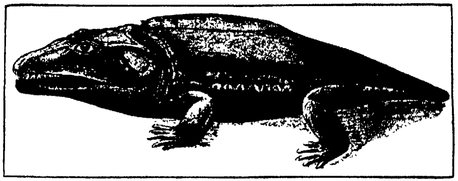
After visiting the site on which the fossil footprints were discovered Dr. John C. Merriam, president of the Carnegie Institution of Washington, conceived the idea of having a permanent exhibit of these footprints prepared, but left in their exact original place.

The sandstone which bears the prints *stands at an inclination of about 30 degrees* facing the trail over which hundreds of tourists pass on mule back. The surface layers were first stripped off, whereupon more footprints came to light, fresh and clean as the day they were formed by the feet of crawling animals in the Permian Period, except, of course, that the sand long ago became sandstone. A smooth surface eight feet wide by 25 feet long, bearing many tracks leading up the slope, was thus uncovered. A flight of stone steps was laid close beside this slab, permitting the tourist to approach and closely inspect the footprints. In addition there are several other slabs of a similar nature close by.

"The great antiquity of these footprints," says the Smithsonian Institution booklet, "which occur from 900 to 1,080 feet below the level of the present rim of the canyon, is clearly demonstrated at this locality. It is obvious that since the day when those animals impressed their feet in what at that time was moist sand, more than 1,000 feet of rock-making materials were piled up in successive strata above them and this does not take into account many hundreds of feet more that have been eroded off from the present top of the canyon wall. The great length of time required for the cutting away or erosion of the rock to form the deep canyon and the even longer time necessary for the original deposition of this great vertical mass of stone is when translated into terms of years, if that were possible, so stupendous as to be almost beyond human comprehension."

Some of the slabs were literally covered with imprints, says the report, and curiously enough all pointed in the same direction, up the steep slope of the sandstone layer, suggesting an old trail leading to the water, or possibly recording a great migration of animal life. Out of all the tracks but one exception to the uphill movement was noted.

The report then describes individually the various footprints, most of which cannot be identified, while some quite closely *resemble those of animals which paleontologists have* found in fossil form. One or two have even been placed in a definite class. The poverty of these results is due to the fact that we have nothing but the footprints of the animals to judge from. Where we have fossils of animals found in other places, whose feet might be identified with the tracks found in the locality under discussion, the identification is less difficult. In many cases we lack even the fossils of animals which could have made the tracks, and until these are found here or elsewhere we must fall back on very slender evidence from which to deduce the *nature of the animal* which made the track.



Smithsonian Institution

***Cacops*, an extinct, primitive amphibian twenty inches long. On the tree of evolution it stood close to the parting of the ways of the reptiles and their descendants the mammals, from the amphibians. *Trematops* was a similar form**

In the illustration showing three slabs of sandstone, the one on the left bears footprints of a new species. The creature that made these tracks was apparently a short, squat quadruped with a wide body and was evidently slow of movement, as indicated by the short stride. Two amphibians of the Permian Period (the period that followed the Carboniferous or chief coal-forming period), *Cacops* and *Trematops*, may be responsible for the tracks. Actual fossils of both these genera (see illustration of *Trematops*) have been found elsewhere.

The center slab shows the tracks of some narrow-bodied creature with long legs. The hindfoot impressions have partly obliterated those of the forefeet, they show that the greater part of the animal's weight was on the hindfeet. A few of the impressions indicate five short, round toes. The slab on the right has been identified as *Laoporus nobeli*, the tracks being beautifully preserved.

Dr. Gilmore of the Smithsonian Institution has planned to return to the site of these discoveries about April first and to spend a month or more searching for new discoveries that will shed new light on the habits of the animals that made these trails.

* * *

An Ingenious Telescope Mounting

IN the "Editor's Mail" department of the April issue of the Scientific American, Mr. Virl Davenport of Quantico, Virginia, narrated his persistent and successful efforts to grind and polish a concave mirror for a reflecting telescope, without the proper abrasives, these being unobtainable. Owing to the fact that he had to finish his grinding with automobile valve-grinding compound having coarse grains of carborundum instead of the fine grains used by telescope makers, it required 200 hours, instead of the usual nine, to do the polishing with rouge. Mr. Davenport has now completed the mounting of his telescope and at our suggestion he has sent us a photograph and description.

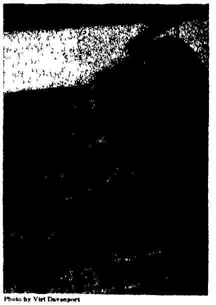


Photo by Virl Davenport

A short-focus, reflecting telescope made almost entirely from parts salvaged from various sources, including a scrap pile

This work was begun a year before the appearance of Mr. Porter's recent articles in the Scientific American (*reprinted in the* book, "Amateur Telescope Making," Scientific American Pub. Co.), but he was able to make use of Mr. Porter's instructions in the final figuring of his mirror.

"The mounting, including the tube and all the fittings," writes Mr. Davenport, "excepting the brass in the adjusting and clamping screws, was obtained from the scrap pile. The base is an aluminum casting, the patterns having been whittled out with a jack-knife and trimmed with a hack-saw blade. The soft pine for the pattern was the largest single item of expense in the whole telescope. With a little knowledge of foundry practice and a few pounds of aluminum from an automobile grave-yard and a good, hot coal fire, any amount of small aluminum castings may be made in the kitchen.

The polar axis turns on ball bearings The axle is a tapered, steel tube, as is the declination axis. The cradle for the tube is made of sheet steel, bent to shape and brazed. The bands encircling the tube are from an old banjo The mirror cell and counter cell and dustcap are "Aunt Het's Favorite Cake Pans" The tube is a length of extra large stove pipe The eyepiece draw tube is the bushing from an old bearing The finder supports are fittings from an old motor boat The polar axis movement is the connecting rod from a gasoline motor The mirror has a diameter of eight inches and a focal length of twenty-four Index circles and a driving clock are next in order, and, of course, a pier on which the telescope may rest"

When the Scientific American stated, several months ago, that a reflecting telescope could be made for less than $50, many people expressed doubt Mr. Davenport has not given us a bill of costs, yet the ingenious manner in which he has extemporized the working parts of his mounting confirms our belief that the average amateur if he will make use of discarded equipment of various kinds, can bring the cost of his telescope considerably within that sum It would doubtless be appreciated by other telescope makers if those who plan to submit photographs of their completed telescopes to the Scientific American for publication, were to keep itemized accounts of all the costs, as well as of the time required for the various phases of the work, and allow us to publish a few of them

The Japanese whose minute freehand writing has attracted much attention

At the present writing, early in March we have heard from nearly a thousand would be telescope makers, and it is likely that by the time the present issue has reached our readers, the majority of those who have purchased the book "Telescope Making" will have already begun work on their mirrors It is therefore pleasant to think, each evening as we begin work in our own little cellar telescope laboratory, that hundreds of others are grinding and polishing their mirrors, and that by midsummer a large proportion of these will be looking at the heavens through them

* * *

Miniature Writing in Japan

"The hand is quicker than the eye!" the expert with the pea and with three walnut shells used to cry at the fair grounds. He proved it to us.

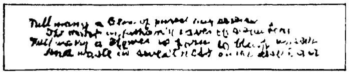
Now comes Mr. Miyake, of Kyoto, Japan, whose slogan is "The hand is more delicate than the eye" By way of proof we reproduce, in the exact size he executed it, four lines from Gray's "Elegy in a Country Churchyard" Only with the greatest difficulty can it be read with the naked eye

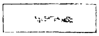
The extraordinary thing about Mr Miyake's writing is not that it is so small, but it is the way he does it Microscopic writing done with the help of magnifiers is not unusual—any normal man with sufficient perseverance can learn to do it—but to write with eyes entirely unassisted, in letters so small that few people can read them at the same time making each line angle and curve so clear cut and distinct as to be read easily under a glass, is something of a feat And this is accomplished with a brush!

One of the examples of Mr Miyake's work which impressed the Empress of Japan when he presented it to her was one hundred poems with one hundred figures of men and women in court dress all done in a space one and three-eighth inches square This task he repeated for a group of Scientific American readers who meet monthly in Kyoto to discuss supernormal phenomena

The question naturally arises how can his hand execute letters which his eye cannot distinguish? The answer is that the work is a sort of sub-conscious activity Placed in front of him you see the open volume containing the "Elegy" After wetting his brush and stroking it to a point Mr Miyake places the tip at the spot where he wishes to begin writing and fixes his gaze on the quatrain which he is to copy His concentration is intense, exclusive, perfect Without conscious direction his hand quivers ever so slightly, in accord with his optic nerve as his eye travels slowly stroke by stroke, over the printed page He sees not what he is writing but the picture before him To write the four lines reproduced in the smallest cut on this page took him twenty minutes

The miniature writing shown below was done with a brush instead of a pen. It is said to be a subconscious form of activity


Full many a Gem of purest ray serene
The dark unfathom'd caves of ocean bear
Full many a flower is born to blush unseen
And waste its sweetness on the desert air

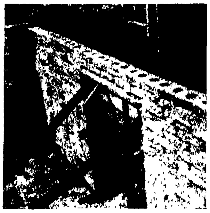

Below: Lines from Gray's "Elegy," just as they were written by Mr. Miyake. Above: An enlargement of this miniature writing

Blocks of Straw Yet Houses of Reinforced Concrete

While seeking to eliminate the enormous waste involved in the erection of permanent wall structures composed of heavy masonry units, of which the weight and strength are utilized to a relatively small extent James Monroe Hewlett, has evolved an ingenious method of building Indeed, this inventor has combined the well-known insulating qualities of a straw-like fiber with the strength and durability of reinforced concrete, and he has dispensed with the cumbersome and costly molds that are usually used

In the new method of building walls use is made of fibre blocks which are laid in much the same manner as cement blocks However these fibre blocks are provided with round holes two to each block, and these must be aligned in building the wall The blocks may be laid in parallel and header courses while half blocks permit of considerable variation of the arrangement At every three courses wire or corrugated strip reinforcing members are inserted in the aligned holes of the blocks, and a 1 2-4 concrete mix is poured into the holes, after which the next three courses are laid—and so on, until the desired height of wall is attained

Thus we have a series of reinforced concrete rods which take care of the compression and buckling strains while the fibrous mass offers an excellent insulation against cold and heat and is an excellent non-conductor of sound The fibrous surfaces inside and outside offer excellent supports for plaster and stucco eliminating the necessity of providing expensive furring strips and lath The fibrous material is fire-proof as well as vermin proof


Fiber blocks are laid like bricks. Reinforcing members are put in the alined holes, which are then concreted

Walls of fiber blocks are not only used for constructing new houses but for remodelling old ones. Here is an old frame dwelling which is receiving a facing of this art, which will later be stuccoed

* * *

America Is Developing a Distinct Type of Man

An American type of man is developing In the older American stock this type has already reached a point where it is possible without much difficulty to distinguish it from the peoples of other countries This is the conclusion of Dr Ales Hrdlicka anthropologist of the Smithsonian Institution of Washington, D C based upon many years of scientific measurements and study of those whom he designates as "Old Americans" and of the immigrants differing from the original stock

"The work as now completed, says Dr Hrdlicka 'shows that the older stock has approached the formation of a distinct American type This type is still nearest to that of its main progenitors, the British but in stature in physiognomy, and in behavior it is already more or less different, American The type is a good one"

He then asks this question "Have we or have we not scientific grounds for fearing racial deterioration as a result of our former liberal immigration policy?" After a thorough comparison of the data he has collected on the Old Americans and the immigrants, he feels justified in answering this question in the negative

These studies give no evidence ' he declares, that the mass of immigrants are bringing inferiority of the body nor judging from the size of the head inherent inferiority of brain Probably all that is necessary judging from the success of the children of older immigrants and even of many of the immigrants themselves is opportunity for wholesome development in favorable American environment Plainly the immigrants on the whole have not brought physical deterioration"

Dr Hrdlicka is Curator in charge of the Division of Physical Anthropology of the National Museum, which is under the direction of the Smithsonian Institution. His conclusions are based upon his most recently collected data and studies, and have been prepared at the request of the American Statistical Association They are now being published by the Pollak Foundation for Economic Research.

Here is Dr. Hrdlicka's description of the American type of man, so far as it has been developed:

"It is characterized by tall stature, being the tallest of all the larger groups of white people; by, on the average, a medium pigmentation of the hair, with scarcity of adult blonds and near-absence of blacks, by prevalently mixed eyes, or light ones showing more or less of a brown admixture, by an inclination, especially in youth, to sinewy slenderness; and by other features The main characteristics of its behavior are, in general, frankness, openness yet shrewdness, energy and persistence, with, in general, but little sentimentality or affectation, and relatively few extremes except perhaps in industrial, financial, and occasionally in religious endeavors.

"This type, contrary to recent unscientific belief, is not Nordic, it is not even nearer the Nordic than it is to the Alpine Like the British, it is an intermediate type The head and skull are on the average mesocephalic; but there is a wide range of variation, with a considerable percentage of brachycephaly The face varies from strong in those working muscularly to decidedly subdued jaws and cheekbones in those in prevalently mental occupations. Otherwise it is a type close to the medium of English and white people in general" [Note The words "mesocephalic" and "brachycephalic" refer to the cephalic index by which skull shapes are commonly expressed It is the ratio of the greatest breadth of a skull to its greatest length, multiplied by 100 Thus, a skull having a cephalic index above 80 is brachycephalic or short, if from 75 to 80 it is mesocephalic or medium If below 75 it is called dolichocephalic, or long—Editor, Scientific American]

The methods which he employed to collect data and arrive at his findings are described by Dr Hrdlicka as follows·

"Up to recent years the belief in an American physical and behavioristic type has rested on a merely empirical and more or less superficial basis Such a type has been represented in art and in literature, but its scientific determination has been wanting It is a well-established fact, however, that people of any nationality, even though of heterogenous origin, after centuries of existence as a linguistic and political group, tend to develop similar habits, similar bearing, similar behavior and gradually even similar physical characteristics, especially similar physiognomy, and thus come to constitute a fairly readily recognizable *type* How far this development has had time to progress in the United States was until recently a moot question The general notion was that a type had developed far enough to be without much difficulty distinguishable from the peoples of other countries

"A critical inquiry into the subject disclosed little of data outside the census statistics, and army and navy measurements (limited to stature and weight), with some records on American children Under these conditions it was natural that at first the greatest use should be made of the census data

"The census records showed that the older American stock, or that dating from before 1820, consisted principally of English and Welsh people or their descendants, with strong infusions of Scotch and Scotch Irish, Germans Dutch, Irish, and French in the order named However, English, and Welsh with their descendants constituted more than three fourths, and English, Welsh, Scotch and Irish not far from nine tenths of the early United States population These figures are of course, only approximate and differ somewhat according to various sources But the main fact is well established the population up to 1820 was essentially of British derivation, and the American type of that time, it is safe to conclude, must have closely resembled that of Great Britain.

"A century has elapsed since then. The unmixed descendants of the families of 1820 are now at least of the third generation Americans. The old components of the stock, except those—and there are many—who have intermarried with more recent comers, have become considerably unified through admixture among themselves Moreover, they have now been exposed to from one to three centuries of the American environment, which in many important respects differs from that of the old countries. This must have had some effect upon the behavior habits and probably even upon the physical type of the old stock, leading it away from British standards toward something more and more American This would seem to justify the assumption that this country may already have approached a separate behavioristic and physical type as far as the older native stock was concerned, and that it remained for anthropology to determine how far this had proceeded and just what the type was

"Anthropologists had recognized this problem long before the late war and many years in advance of the mischievous, pseudo-scientific literature which during the last decade has flooded this country and spread alarmistic untruths, bias, and intolerance This led me to undertake a detailed physical and partial physiological study of the living representatives of the Old Americans"

As to the effects of immigration, Dr Hrdlicka says

"These data show that during the last one hundred years this country has received, proportionately to its earlier ethnic components, many more Germans, Irish, Scandinavians, Italians Slavs, and Jews, and a considerably smaller percentage of Scotch, Welsh, English, Dutch, and French The addition of the new to the older blood, which meanwhile has probably more than quintupled through natural increase, will probably result in a population somewhat more German and Irish, with also a tinge more of Scandinavian and a stronger tinge of Italian, Slav, and Jewish blood than formerly. The great bulk of the population remains, however, in origin of descent, British, or at least Western European. This does not mean much anthropologically. The peoples here named are not distinct races. They are at most more or less recent types. No such type deserves to be called a 'race' unless this term is used loosely, though presumably the type would develop into a race or strain of distinct, fixed character if it had a chance to persist over thousands of years in isolation.

"The various types of white men now existing differ from each other mainly in accordance with their composition from previous types. Thus the German type is a composite of Northwestern Europeans, Slavs and Alpines, in perhaps not greatly differing proportions. The French type results from the admixture of Alpines, Mediterraneans, Southwestern Germanic tribes, and some Normans

"The present English type is derived from the Neolithic type of man in Britain, the broad-headed Central or Western European type that reached the islands during the Bronze period, the Mediterraneans brought in during the Roman domination, the Germanic tribes of what is now Western Germany and Holland, and the Norman, French, and smaller admixtures The Slavs are Old Europeans, modified according to locality by the Finno-Ugrians, Scandinavians, Germans, Alpines, Italians, or Turks. The Hungarians are a mixture of Slavs, Dacians, Saxons, Roumanians, Magyars, Szekels, and others. The Italians are descendants of the Latini, Greeks, Etruscans, Gauls, Goths, Slavs, Langobards, Albanians, Phoenicians, and Sards The Jews carry the blood of every people with whom they have lived. And so with others. Upon analysis every larger European group, even the Nordic or Scandinavian, is found to be a composite of older groups which generally represent all the three main strains of white men, namely, the Nordic, Alpine, and Mediterranean. Most, if not all, have also more or less of a trace of the yellow-browns or blacks."

Dr Hrdlicka's study shows that:

"The bulk of the immigrants represented in our records, outside of head form and a few other features, are remarkably uniform in physique, with the exception of the Jews and the Southern Italians, both of whom are characterized by smaller stature and other more or less aberrant features. They are, in general, a good, sturdy lot. In average stature, in size of chest and in muscular strength, they are above the mean of the Europeans. They present, as groups, no signs of physical degeneration."

* * *

What Kind of Paving Wears Motor Tires the Least?

SOME remarkably interesting tests have been made in order to determine the relative degree of automobile tire wear on concrete roads, as well as on good macadam roads and very poor, rough macadam roads; also in order to determine how much the temperature of the air effects tire wear. The results of three groups of experiments have been abstracted by *Automotive Industries* (New York) from bulletins of the Bureau of Public Roads of the U. S. Department of Agriculture (Washington, D. C.), from those of the Engineering Experiment Station of the State College of Washington (Pullman, Wash), and the Engineering Experiment Station of the Iowa State College (Ames, Iowa)

It was found that there is an immense difference in tire wear between concrete roads and various macadam roads. Also that as temperature goes up, tire wear increases to a surprising degree.

In the case of the Washington College tests, the chief object was to determine whether the saving in fuel and tire wear due to good roads, warrants the increased cost of such roads. Tire wear was determined by removing the tires, with the rims, from the cars, cleaning them thoroughly, deflating them and weighing them on a sensitive balance This was done both before and after a test run The average of the weight of rubber worn from four tires was taken. Runs of fifty to seventy-five miles proved sufficient for decisive results, except on concrete roads

This, by the way, speaks loudly for that kind of roads. New tires should not be used in these tests, as the sharp edges wear off unduly at first; while old tires are apt to lose large particles or flakes of rubber

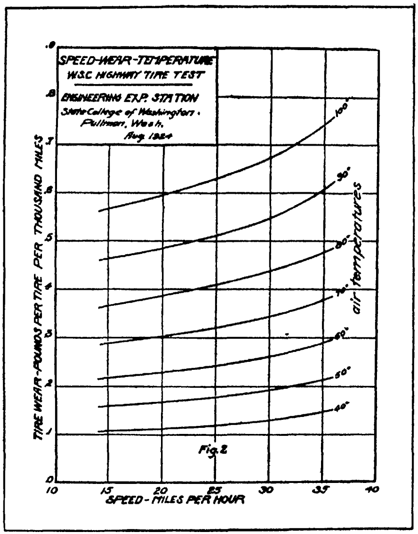
It was found that rubber cuts more rapidly when wet than when dry It was also found that the temperature of the air has a great deal to do with tire wear, as the graph which we reprint shows. One might expect a few percent increase in wear, due, for example, to the rise in temperature from that of a frosty morning to a hot noonday, but the rise of about 700 percent indicated on this graph is a distinct surprise

Speed, on the other hand, does not bring about as great a difference in tire wear as temperature does. Take, for example, a spring day at sixty degrees, Fahrenheit. At fifteen miles per hour the wear is about 22 pounds per tire per 1,000 miles Increase your speed to double—thirty miles per hour—and the wear only increases to about 27 pounds per tire for every 1,000 miles

Those of the tests which were made by the Engineering Experiment Station of the Iowa State College show that with a Ford touring car the fuel consumption on poor macadam roads ranges from 100 percent to 147 percent of the consumption on concrete road; but tire wear showed a much greater difference than this, the treads wearing off about seventeen times as fast on good macadam, and *fifty-six times* as fast on very poor macadam as they did on concrete

It is pointed out, however, that the latter figures are likely to be misinterpreted, and disappointment is in store for him who expects to get fifty-six times the mileage on a concrete road that he gets on a poor macadam road! That is due to the fact, which will be obvious to everyone, that other factors as well as this one, limit the life of the tire.

(*Continued on page 334*)



Courtesy of Automotive Industries

How temperature and speed affect tire wear. Speed increases it slightly, while temperature increases it greatly

Which Fire Are You Choosing?

Fires *Are* a Matter of Control

Consider this example. A lighted cigar falls into a waste paper basket. If the basket is combustible the fire spreads to a rug, then to a desk, also of combustible construction. Later the fire follows the rug to a file and a stenographer's desk. The entire contents of the office are consumed but there the fire stops. Sheet Steel partitions, doors, and trim bar further progress. The example is real—it happened in the Guardian Building at Cleveland.

But the example is far from ideal. Think what would have happened if the waste basket and the office desks and files had all been of Sheet Steel construction. The fire would have burned itself out in the waste basket. A scorched rug is the most that could have happened.

Now here is the point that fire was chosen when the owner chose office equipment. Had he chosen steel when he made his purchase he would have had a waste basket fire.

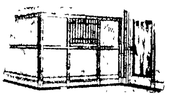
It was choice that stopped the fire—the choice of Sheet Steel partitions, doors and trim. Without them a floor or the complete building might have been heavily damaged. The historic case of the Burlington Building at Chicago proves this possible.

It will pay every business man to give the closest attention to the question of fire control when choosing materials for factory or office equipment as well as for building construction. No one questions the desirability of fire-resisting construction; fire-safe contents are just as important.

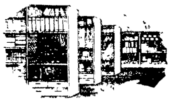
MASTER TEC BRAND REGISTERED U.S. PATENT OFFICE

Several articles dealing with this vital item of fire have appeared in the booklet, "MAKING MARKETS," which is issued regularly by the Committee. Copies will be gladly mailed those interested on request.

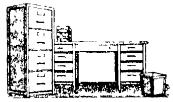
SHEET STEEL INC.
TRADE EXTENSION COMMITTEE
OLIVER BUILDING
PITTSBURGH PENNSYLVANIA



Sheet Steel partitions both increase the fire-safety of buildings and provide for re-arrangement to meet changing conditions. Compact, economical, easily cleaned.



Shelving of Sheet Steel provides the place for everything that is essential to keeping "everything in its place." In many instances steel has reduced space requirements as much as fifty per cent.



Sheet Steel furniture is easily cleaned, durable and economical. It greatly increases fire-safety by reducing the amount of combustibles and by retarding the rate of combustion.

Expanded metal lath—made from Sheet Steel—gives permanence to the beauty of plaster walls and also adds greatly to the fire safety of the building.

MASTER TEC BRAND

Look for this Master Brand. It assures you—that the sheets furnished for your service are of standard prime quality—that they are of the gauge stamped on the sheet—if galvanized, that the coatings for the various gauges and uses are the weight and quality established by standard specifications.

Sheet Steel which bears the Master Brand, can be depended upon to give economical and lasting service.

These Are

Bolt Clipper Times

VOL. I EVERETT MASS. U.S.A. NO 1

Saving time with a Bolt Clipper

You certainly start a life job when you undertake to discover all of the innumerable ways in which a bolt clipper can be used around the shop, the factory and the home Every time you discover a new use you find a new way to preserve the purity of the English language and to increase the value of your working day because a bolt clipper does its work without the aid of strong language and does it quickly. Bolts, nails, wire, rods and chains are essential contributions to housing, transportation, power and construction, from the hen coop to the concrete road, from the wheelbarrow to the motor bus

Cutting Heavy Fence Wire

Perhaps you don't know what a bolt clipper is?

It's a tool for cutting off rods, bolts, heavy wire and chains to desired length, anywhere

When we say bolts we mean big husky ones up to ¾" in size—the kind you find around the automobile mud guards, holding the door plates to the furnace or the sides on the kitchen stove When we say rods we mean anything from the brass rods which hold up the parlor curtains to those husky iron reinforcements you see in concrete walls

By wire we mean the clothes line, the radio aerial, guy wires on poles and fences as well as insulated wire on power lines, cables, etc

As to chains—well of course there are limits to what even a bolt clipper will do but when it comes to the broken links on a tire chain—just reach for the bolt clipper and snip off the broken cross chain

Our message to the readers of *Scientific American* must be general because this magazine reaches all sorts of tool users—men in all walks of life When we talk to the automobile mechanic, the road builder, the railroad man and others we can deal with specific uses in each one's work—but in this issue of the Bolt Clipper Times we can suggest only a few of the thousands of general uses to which the hundreds of thousands of readers may apply this tool. A bolt clipper belongs in every tool kit, on every work bench, in factory, home and farm shop and is an essential item of equipment for railroad construction men, repair crews on power and telephone lines, on ships, fire department apparatus, in mines, lumber camps—and wherever time saving is essential and man power limited

Cutting Fender Bolt in Hard to Get At Place

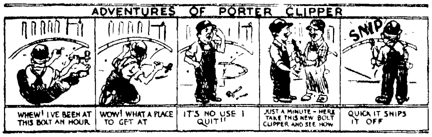
Housewife Cutting Brass Curtain Rod

To those of you who are unfamiliar with these tools just imagine a device so powerful that it will cut a quarter inch rod as easily as the ordinary nipper cuts the small wire on a radio set Imagine a two handed tool multiplying man power seventy times. Imagine splitting the nut of a bolt in one operation with moderate effort or snipping off a wagon bolt almost as easily as a pair of scissors cuts a piece of twine

Every hour of every day some man somewhere is laboriously wasting time making work out of a job that should be done with a bolt clipper If you use tools or if you employ men who use tools we suggest that you write to us or to your tool supply dealer for booklet describing the Porter line of cutting tools Write to dealer or to H. K. Porter, Inc, Everett, Mass, U S A

Splitting Nut on Brake Drum

ADVENTURES OF PORTER CLIPPER



WHEW! I'VE BEEN AT THIS BOLT AN HOUR
WOW! WHAT A PLACE TO GET AT
IT'S NO USE I QUIT!!
JUST A MINUTE - HERE TAKE THIS NEW BOLT CLIPPER AND SEE HOW
SNIP
QUICK IT SNIPS IT OFF

Barnes Electric Bench Scroll Saw

Not a toy, but a practical, useful tool for shop or home Runs from lamp socket

Price includes boring attachment, emery wheel, etc.

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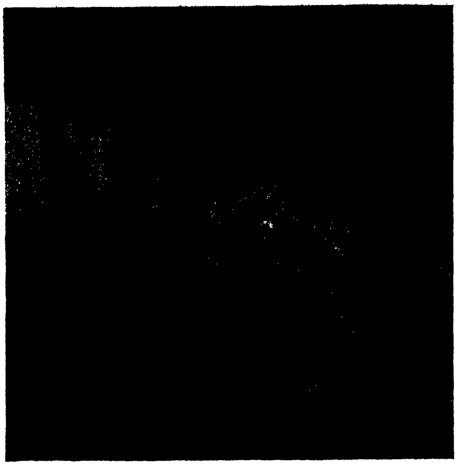


How the clean oil is separated from the solid matter and washing solution

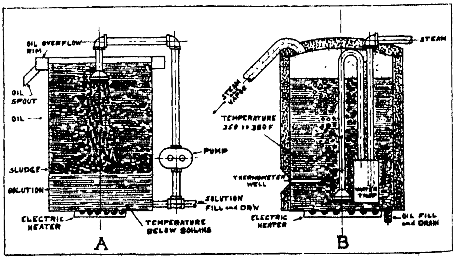
A Simple Method of Reclaiming Old Crankcase Oil

THE tremendous waste of food material that is going on all the time, due to throwing away the drainings from automobile crankcases has impressed itself upon most automobile owners In city garages, these drainings are sometimes worse than useless at the present time for city ordinances prohibit throwing them into the sewers, and they become a burden on the hands of the garage proprietors.

With a very general interest in the subject in the last few years, and the development and use of numerous oil purifying devices, the amount of this waste is being rapidly reduced It was the good fortune of Mr C D Miller, Associate Agricultural Engineer of the Alabama Polytechnic Institute to have worked out a process for reclaiming the drainings, that is simple, inexpensive and effective, and that can be used to handle them in small or large amounts as may be required The process seems to be capable of such general application that every drop of oil that is drained from a crankcase anywhere, can be profitably saved and returned to a condition of usefulness equal to that of the new oil Whether this estimate of the process is correct, remains for the reader to judge and for developments to determine

As a preliminary to the description of the new process, it may be of interest to cite briefly an older process, of which the new one is a development. As this older process seems to have originated with the De La Vergne Machine Company, makers of Diesel engines in New York City, it may be designated as the De La Vergne process It has been used with good results in some cases, and in others, it has been a complete failure With oil from the army flying machines, it has been used successfully, apparently on account of the quality specified for both the lubricating oil and for the motor fuel or gasoline It has not been found to work out satisfactorily with the general run of automobile crankcase drainings, on account of two difficulties One is that some of the oils being used will emulsify when an attempt is made to treat them in this way, the resulting mixture of oil, treating solution and sludge being a hopeless mess, impossible to separate in a practical way The other is that the temperature of saturated steam at atmospheric pressure is not sufficient to volatilize the heavy kerosene-like constituents of commercial gasoline that are absorbed by the oil The result is that even if the oil does not emulsify so that it can be treated with some measure of success, the product is thin and lacking in body, whereas in order to be entirely successful, a reclamation process should restore the oil to its original body as a new oil, by the complete removal

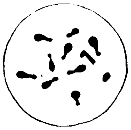
(*Continued on page 336*)



***A* is the cleaning tank, in which the oil is treated and separated from its solid impurities. *B* is the steaming tank, in which the absorbed gasoline is carried out of the hot oil by means of steam**

[illegible] We'll make a little wager with you that if you try one tube of Listerine Tooth Paste you'll come back for more. LARGE TUBE—25 CENTS

DANDRUFF?



Bottle Bacilli, the cause of Dandruff Illustration Reproduced from Hazen's "Diseases of the Skin" C V Mosby, Publisher

Dandruff, known scientifically as Pityriasis Simplex Capitis, is a disease of the deeper rooted cells of the scalp

It may spread by infection through personal contact (combs, brushes, etc) Many people, for instance, and especially children, are free from the disease until infected by actual contact with dandruff bacteria

Dandruff is a disease difficult to cure, but easy to check

When checked it has a persistent tendency to reappear, and often in more virulent form, with possible loss of hair or even total baldness

The treatment to check dandruff requires constant cleanliness and the use of a suitable antiseptic solution to combat the disease and to heal the scalp

Do something about it!

DANDRUFF is a danger signal. If you have it you should do something about it

Perhaps you never knew it before, but dandruff is a germ disease. It spreads by infection from personal contact, as with the common use of combs and brushes. Children, for instance, are never troubled with dandruff until actually infected by some contact.

Dandruff is a disease difficult to cure but easy to check. It has a tendency to reappear, unless properly treated, and often brings with it the possible loss of hair or actual baldness.

The ideal treatment to combat dandruff conditions is the systematic use of Listerine, the safe antiseptic.

We have received hundreds of unsolicited letters from Listerine users, who are most enthusiastic in their claims for what Listerine will do in this way. If you are troubled with dandruff you owe it to yourself to try it.

The use of Listerine for dandruff is not complicated. You simply douse it on your scalp, full strength, and massage thoroughly. The effect is antiseptic, cleansing and healing. And you will be amazed to see how this treatment, followed systematically, combats dandruff.

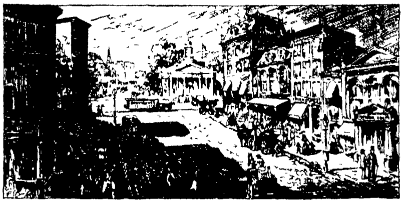
Moreover, Listerine will not discolor the hair nor will it stain fabrics.

Not only men but women have become devoted users of Listerine for this purpose—women, particularly, since bobbed hair has been in vogue and has made them more conscious of dandruff if it happened to be present

Try Listerine some evening when your scalp feels tired and itchy Dandruff is probably causing the trouble. Apply it generously and then massage vigorously You will find it a stimulating tonic for the scalp, and in addition to combating dandruff, you will find that it adds that luster and softness to the hair that is so important a part of being well-groomed.—*Lambert Pharmacal Co , St. Louis, U. S. A.*

LISTERINE

—and dandruff simply do not get along together



The Telephone and Better Living

PICTURES of pre-telephonic times seem quaint today. In the streets were horses and mud-splashed buggies, but no automobiles and no smooth pavements.

Fifty years ago homes were heated by stoves and lighted by gas or kerosene lamps. There was no domestic steam heating or electric lighting, nor were there electric motors in the home. Not only were there no telephones, but there were no phonographs, no radio and no motion pictures.

The telephone permitted the separation of business office from factory and made possible the effective co-ordination of widespread activities by a centralized organization. It changed the business habits of the Nation.

The amazing growth of the country in the past fifty years could not have come had not science and invention supplied the farmer, manufacturer, business man and family with many new inventions, great and small, for saving time and labor. During this period of marvelous industrial progress, the telephone had its part. It has established its own usefulness and greatly accelerated the development of the industrial arts which have contributed so much to better living conditions and to the advancement of civilization.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

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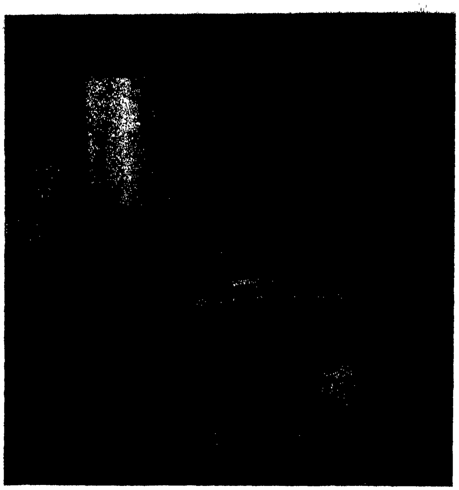

The coagulation of the contained solid matter by means of chemical treatment

of the diluting material absorbed by it in use

In the new process which we will now describe, the solid matter and the absorbed motor fuel or gasoline are removed in two distinct operations The difficulty of emulsification is entirely avoided, and the gasoline is *completely removed*, so that the oil is entirely restored to its original body as a new oil The difficulties mentioned in the treatment of ordinary crankcase drainings are overcome entirely The first operation is the removal of the solid matter by a chemical washing and settling treatment. The second is the *removal of absorbed gasoline* by steaming at a relatively high temperature

The successful treatment of an oil having a strong tendency to emulsify, depends upon the discovery that emulsification of the oil with the treating solution does not occur so long as there is no contact between the two in a free liquid surface, such as where there are bubbles of steam or air passing through *the intermingled liquids* The contact necessary to obtain the coagulating action is obtained by introducing the treating solution beneath the surface of the oil in a broken stream, in the center of the treating tank The solution passes down through the oil, settling out at the bottom, where it is withdrawn as fast as it enters, to be returned above and to pass again through the oil This produces a circulation of the oil, down in the center and up around the outside, so that the entire mass of oil is brought into contact with the solution There is also a tendency to leave the coagulated solid material at the bottom of the oil in this circulation, on account of the relatively slow *motion in the outer parts, where the oil is* rising The liquids are heated before the washing is begun, and kept hot not only during the washing, but long enough afterward to permit the solid material to settle while the oil is thin, as it is, while hot.

This part of the process is illustrated in the accompanying diagram. *A* is an electric disk heater, for heating the contents of the tank, a gear pump is shown for taking the solution from the bottom up to the nozzle above, from which it passes down through the oil in a broken stream After the treatment and settling, water is run in below to run off the cleaned oil, which passes over the upper rim of the tank, into an annular part marked "*oil overflow rim*." This is open at the top, as is the tank, allowing the oil to pass over, and permitting easy access and visual inspection of the oil as it comes over From the overflow rim, a spout drains the oil to a receiving vessel. The sludge is best removed by dipping, after the last of the oil has been run off On account of its thick, sluggish nature, much labor in cleaning is avoided by keeping the sludge out of the overflow rim as far as possible Arrangement should be made to catch the oil stream in a separate vessel on the first appearance of the least particle of the sludge, so that the oil previously run off remains entirely clean

In the diagram, *B* illustrates the apparatus used for getting rid of the kerosene like constituents of the gasoline that have been absorbed by the oil. The removal of these constituents, known as the "heavy ends" of the gasoline, completes the reclamation of the oil The oil is heated up to a temperature of 350 to 380 degrees Fahrenheit, and *from the time it is a few degrees above the* boiling point of water, steam is blown through it Any water coming over with the steam is caught in the water trap, and the steam is at the same time superheated to the temperature of the oil The exact temperature to which the oil should be heated depends upon the drainings and upon the body desired in the reclaimed oil, the body, or thickness of the oil increasing with an increase in the temperature When the oil has reached the right temperature, the heat and steam are shut off, and the oil is allowed to cool, when it is ready for use. Care must be taken not to shut off the heat from the steam generator without admitting air *to the steam line leading to the oil tank*; otherwise, the condensation of steam within the generator will draw over the oil, into both the water trap and the steam generator Three quarts or more of the good oil will be recovered from four quarts of ordinary drainings

A simple apparatus that has been found very effective for treating small quantities of oil is shown in the first half-tone. The washing is carried out in a ten-quart pail, provided with a spout at top and an outlet with shut-off cock at the bottom. The upper tank contains washing solution. The flow of solution from the upper tank is regulated by a cock, and the flow from the ten-quart pail is regulated so that it just balances that from the upper tank. The solution is caught in the pail below, which is occasionally emptied back into the upper tank. After an overnight settling, the clean oil is run out of the pail as illustrated in the second halftone, by forcing water into the bottom of the pail of treated oil, thus floating it up.

The steaming tank is made of a five-gallon kerosene can. A well-crimped and soldered can has been found to hold, although the solder softens at temperatures to which the oil is raised, but all joints of this tank were brazed, for safety.

* * *

Can Stars Be Seen by Daylight?

From time to time within recent months we have noted numerous letters in various scientific publications, concerning the visibility of stars in the daytime, especially from wells and mine shafts. There seems to be considerable misconception in this connection. Thousands of people have seen one of the *planets*, Venus, *in* broad daylight, but Venus is not a star. Stars are not visible to the naked eye, either from the bottom of a well or from a silo. They are too faint.

In a recent issue of *Popular Astronomy*, (March, 1926, Northfield, Minn), Prof C. C. Wylie of the University of Iowa makes out a rather amusing case against the alleged daylight visibility of stars Professor Wylie had previously challenged the oft-repeated assertion that certain stars could be seen from the bottom of silos In reply an Indiana reader then made the claim that if the Professor would come to his home he would convince him of his error by taking him to a 70-foot silo. "I myself have plainly seen Ursa Major, Algol and Capella in the early afternoon of a September day," he wrote, naming the exact date of their observation

The Professor suggests that someone try this experiment in agricultural astronomy in September, since Ursa Major at the time named was 45 degrees from the zenith, and he says he doubts whether the silos in that region lean at a 45-degree angle! Also at the date and hour named, Capella and Algol were below the horizon. He then explains the customary manner of showing a curious and eager amateur astronomer the stars from the bottom of a silo. Of course the man cannot see the stars, so he is coaxed to lie down and view the sky upward through an empty coat sleeve, the coat being well wrapped about his head A bucket of cold water is then poured down the sleeve

Professor Wylie then makes the following unequivocal statements.

"1 Men with years of experience in mine work report never having heard of anyone seeing a star by daylight from a mine shaft

"2 The silo, or mine shaft, does not change the contrast between star and sky background. The telescope changes it hundreds of times. From daylight work with a telescope it can be computed that Venus is the only 'star' bright enough to be so seen without changing the contrast.

"3. Daylight observation of Venus from rooms with high southern windows indicates it must be about 30 times as bright as Vega to be observed by day without optical aid.

"4. In the evening, the fixed stars are noticed from a high window of a darkened room, or from a silo, at about the time they can be seen from anywhere out of doors

"As far as I know, no observations have been taken especially to answer this question. We have many facts gathered in connection with other work; but considering the number of educated people ready to believe stories such as this one from Marion County, Indiana, it would seem worth while for some one with access to a high silo, a mine shaft, or a tall chimney, to make a few observations. I would suggest the observation of some bright zenith star, such as Vega, when it is on the meridian in twilight. Record first, the time it is seen over the silo or chimney, and second, whether it can be seen from outdoors immediately after noting the time. Continue until the star is lost in daylight."

THE side-hill farm with its horse drawn plow and its man power has ceased to be of importance in the agricultural industry Power machinery with its great capabilities now tills the soil

In the production of agricultural implements the modern grinding wheel and precision grinding machine make possible comparatively low costs because of high and uniform production with accuracy.

The tractor rolling its way across the great grain fields, as well as the plows and harrows, the reapers and mowers that work with almost human skill, are machines that grinding makes perfect in operation. Practically every farming implement is now produced with the aid of the grinding wheel

This is but one of the great industries of the world that have made marked advances as a result of the discovery and development of electric furnace abrasives The abrasive "Alundum" is now used in grinding and polishing in the metal working plants of the world It is making floor materials slip-proof and safe to walk on It is serving the chemist and power plant engineer in the form of laboratory ware and refractories

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Science and Money

Bonds—A Technical Consideration

By Henry C. Trundle

FINANCIAL expediency has brought many types of bonds upon the market. First investors are bewildered by the maze of varieties in security offerings, and often funds are not properly invested because of the lack of knowledge of technical differences, market considerations and personal requirements.

Until the Liberty Loans came along, bonds were familiar practically to only the rich. As a part of the war program it was desirable to interest everyone financially. Likewise it was necessary to call upon the person of moderate means to subscribe to these Loans, for the rich alone could not raise the money required to conduct the war. Thus it was that bonds were issued in denominations as low as $50, and even sold on the partial payment plan. So new was the idea of bond ownership, that many neglected to cash their interest coupons and others considered their purchases purely as gifts to their country.

Huge amounts of Liberty Bonds were sold rapidly, revealing a new type of investor. Capitalizing their experience, financiers adopted the policy of issuing bonds in $100 and $500 denominations, as well as in the usual $1,000 pieces.

Quite naturally the obligations of one's country are regarded by its citizens as of the choicest quality. In the United States, in the British Empire or in other countries of good financial standing, therefore government securities will be found to be selling higher than any other class of domestic offering. The credit of nations is based upon the ability to levy and collect taxes sufficient to pay expenses and interest. If the national wealth is large and if the government is fundamentally sound, the safety of such issues is unquestionable and will be reflected in the market price.

Wide Fluctuation in Foreign Bonds

The unfamiliarity of investors with the resources, customs and people of foreign countries makes it necessary to induce Americans to extend a credit through higher rates of interest or other considerations. War threats and declining money values, et cetera, recently have caused much apprehension to the holders of foreign bonds, resulting in wide fluctuations in price. Only in a few instances in the history of foreign loans, however, has actual default occurred. As it may be necessary to seek external credit again, nations see to it that their outside debts are paid, whatever action they may take regarding their internal obligations. Bankers are sincere in their statements that investors will realize too late that in the present years many opportunities were offered them in foreign government and industrial bonds to obtain exceptional security and high yields at ridiculously low cost. Already some of these bonds are selling 10 and 20 points above their levels of a year or two ago.

Those who do not like United States Government securities because of their low returns or foreign bonds because of their uncertainties, but who do prefer the obligations of governmental bodies find in state, county and city bonds both the safety and the income yield they desire. Such bonds are purchased principally by persons living within the borrowing districts, and have therefore a limited market.

Possibly the next preferred investments are real estate and railroad bonds. This department has only recently discussed the excellent character of real estate mortgages, so we will turn to the latter type. Huge sums were required to finance the building of transcontinental rail systems and the money was obtained at then very attractive rates. Because of the scarcity of investment opportunities, and the large potential earnings capacity of the companies, railroad securities soon gained for themselves a strong position which as a class has been maintained.

The outgrowth of railroad development and national progress has been industrial expansion and consolidation. Money requirements for these were larger than the private fortunes of the business builders. The public therefore put up the necessary capital, accepting as security *the bonds of the companies*. The hazards of business are such, however, that all investments in industrial bonds have not turned out well, finally, nor have they been entirely satisfactory during the time of ownership. Depressions in specific lines, competition, or errors in management policy are frequent enough so that it is absolutely necessary that investors consider carefully their proposed commitments and that purchases of industrial issues be moderate in relation to the total account.

Public Utility Bonds

Dependent somewhat on industry, and yet not enough to encounter difficulties in hard times, the business of public utility companies is remarkably stable. The services provided by such companies—electricity, gas, water, transportation and ice—are essentials of every day life, and as these are provided practically without competition, full opportunity is given to build up a large earning power. In contrast to the history of railroads, public utilities have been developed with legislative approval, avoiding the expense of legal entanglements. They now are conducted under the general supervision of state commissions, which fact is assuring to the cautious. Electric and gas plants and water works operating under local management in small communities are being replaced by interconnected systems which take in hundreds of cities and which are directed by men of great administrative and financial experience. The service obtained is better and cheaper. To accomplish the necessary consolidations and to finance the new constructions billions of dollars are required. Bond offerings of public utility companies have been in profusion in recent years and future requirements appear to be as great.

In principle, the first mortgage is the best security, although it is evident that the promise to pay of one person might be better than the secured obligation of another person. A first mortgage bond has a first claim on the property of the company, as well as upon the earnings. Usually mortgages are placed to only 50 to 80 percent of the property valuation. In earlier times it was customary to limit the amount of bonds that could be issued through a "closed" mortgage. This has hindered development because it has been impossible under the terms imposed to use additions and betterments as collateral for further financing. It is the modern method to have "open end" mortgages which allows companies to issue bonds up to say 80 percent of the total property valuation, provided earnings conform to certain requirements.

Such names as "First and Refunding," "First Lien and General," "Collateral Trust" and "Debenture" are frequently used in modern financing, but bonds so named may not actually be as well secured as they appear. Due to the inability to always be able to place a first mortgage on a property because of prior encumbrances, and due to the aversion to second or tenth mortgages, such mortgages are camouflaged through the titles "First and Refunding," et cetera. An analysis will show that the first claim is only on a small part of the property, the real security being a junior claim on the balance. In complex situations it is preferable to deposit bonds and/or stocks of constituent companies and issue a "Collateral Trust" bond against them. They may therefore be in effect a first mortgage and can be purchased safely with discrimination. "Debenture" bonds are the unsecured obligation to pay, and are used by companies with strong credit or by those with no assets to pledge

An entirely new development is the "Equipment Trust" Certificate which is used by railroads and motor bus companies to finance the purchase of rolling stock If these certificates are issued under "The Philadelphia Plan," they are generally regarded as of prime quality. Under this Plan, the company pays down say 20 percent of the cost in cash and retires a certain amount of the certificates each year Title to the equipment is vested in a trustee until final payment is made The company is required to keep the equipment in good condition during the life of the loan. It is evident, then, that the equity is increased as fast as the certificates are paid off In other words, there might be but $100,000 of certificates outstanding, secured by equipment worth two or three million dollars In the event of default it is a simple matter to run the locomotives, freight cars or busses over to a new purchaser and receive payment for the indebtedness

Exercise Your Conversion Privileges

All companies cannot find a buyer for their securities with the same readiness, nor at the same favorable price. It then becomes necessary to add features which will carry an appeal sufficient to attract investors The disadvantage of low returns from government and municipal bonds is overcome through their being tax-exempt. Another familiar feature is the right to convert into stocks For instance, the Debenture Bonds of one company were sold to the public at a price of 100. Convertible into common stocks these bonds attained a price of 172, fluctuating in direct relation to the common stock quotations Incidentally, millions of dollars have been lost by investors who failed to exercise their conversion privilege, or who neglected to sell their bonds prior to the expiration of such rights This loss is inexcusable since every effort is made by companies, newspapers and investment houses to bring this matter to the attention of the bond holders.

Still another feature which is used extensively is the right to redeem the bonds at a price several points above par, either by call by lot, or by redemption in part or as a whole This option is inserted by companies which believe they can borrow on more advantageous terms at a later date This feature has made it possible for investors to speculate mildly, without in any way considering their investments as a speculation. For example, $2,300,000 Kingdom of Belgium 7½s are drawn by lot for payment each June at 115 These bonds at one time sold in the 80's and if one was lucky, one could have had his bonds paid off at 115, and purchased others of the same issue at say 85, a clear gain of $300 per bond At no time during these transactions was there any change in security value Bonds with this feature were in demand and many companies were thus enabled to finance themselves.

Sometimes instead of conversion privileges or attractive call features, a bonus in the form of shares of common stock is given with each bond. Or a warrant may be attached giving the right to purchase stock at a fixed price within a certain period. The purchasers of one such bond were recently agreeably surprised to find that they could sell their warrants for more than the original cost of the bond and they were further fortunate in having their bonds called for payment at 104. As interest had been paid at the rate of six percent in the meantime, the investment turned out to be most profitable.

Many of the preceding points have little

To Crate Users
Weyerhaeuser
now introduces
"Cut to Size"
Crating Lumber

ON top of the savings they have already effected for the industrial men of America, Weyerhaeuser now comes forward with a still further contribution toward economies in crating and transportation costs.

Briefly, it is this:—

To the manufacturer who has standardized, or who can standardize, his crates, Weyerhaeuser is prepared to furnish Crating Lumber *Cut to Size.*

This Weyerhaeuser *Cut to Size* Crating Lumber is of standard kind and grade as specified for the individual crates. It is cut to the required length, width and thickness for each individual crate and is shipped in bundles ready to assemble.

Weyerhaeuser *Cut to Size* Crating Lumber is prepared only at the Weyerhaeuser Mills. It can be supplied only in carload lots. And each car contains all the pieces needed to make a specified number of standard crates.

There will always be some manufacturers and shippers who will find it necessary to buy their crating lumber in bulk and do the cutting up in their own establishments, and to these Weyerhaeuser offers a dependable supply of *ideal, light weight* woods in grades best suited to their purpose.

But the man who can and will follow the Weyerhaeuser Crating Service every step of the way, including this new *Cut to Size* offering—may expect *Eight Specific Savings* (and maybe Nine) as enumerated in the right hand column.

It is worth thinking about. We invite your correspondence.

A Carload of Lumber is about 25,000 Board Feet. Buy your Crating Lumber from Weyerhaeuser Cut to Size.
All good crating pieces.
No waste.
No dead freight loss.
No labor cost for cutting up in your shipping room.

Savings

Saving No. 1
No freight on waste You pay freight only on the finished pieces, the waste that develops in the cutting up process is disposed of at the source

Saving No. 2
Lower lumber costs per crate Weyerhaeuser Cut to Size Crating Lumber is cut at Weyerhaeuser owned mills Therefore a Weyerhaeuser Cut to Size Crate is strictly a "one profit" crate.

Saving No. 3
Lower labor cost per crate Weyerhaeuser Cut to Size Crating lumber is worked up by men who specialize in doing this one thing for hundreds of customers In most cases, therefore, they can do it better and cheaper than the individual customer can do it for himself

Saving No. 4
Lower overhead cost because it cuts the "no profit" operations of a shipping room to a minimum It releases valuable space for *profit making*

Saving No. 5
Less weight per crate Weyerhaeuser crating lumber is ideal for crating purposes—strong, easy-working, non-splitting but *also light in weight* and that saves freight cost on your shipments

Saving No. 6
Less lumber per crate Weyerhaeuser Crating Engineers know how to build *efficient* crates with a *minimum of lumber*—often 10% to 30% *less lumber* than many shippers formerly used And that saves again on shipping weight.

Saving No. 7
Fewer adjustments and claims for damaged shipments, because a Weyerhaeuser designed crate is not only stronger but specifically better protection for the merchandise packed in it

Saving No. 8
The good will value of an efficient, good appearing package.

Saving No. 9
Many times, a Weyerhaeuser designed crate has given the shipper the advantage of a more favorable freight classification and that means a lower freight rate

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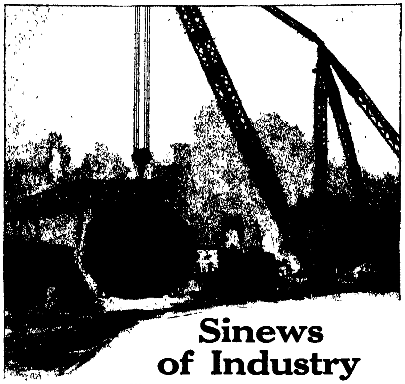
Also producers of Idaho Red Cedar poles for telephone and electric transmission lines

Weyerhaeuser Forest Products are distributed through the established trade channels by the Weyerhaeuser Sales Company, Spokane, Washington, with branch offices at 208 So. La Salle St., Chicago; 220 Broadway, New York, Lexington Bldg., Baltimore; and 806 Plymouth Bldg., Minneapolis; and with representatives throughout the country



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Eliminate the Loss in Investments

For after all good investment opportunities predominate Caution, Care, Investigation will reveal safe and profitable channels for your surplus funds.

The Financial Article that appears in the May issue of *Harpers Magazine* will help solve your investment problems.

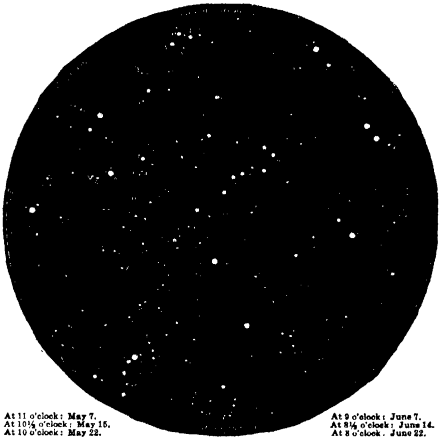
Harpers
MAGAZINE
49 East 33rd Street, New York, N. Y.

meaning for the ordinary investor, who seems to concern himself only with price and yield. These factors are based directly on security, marketability and other specialized features such as tax exemption or legality for investment of trust funds. Another determinant of price in the case of United States Government bonds is the specialized use, for instance, to which they are put by banks in securing circulation of money Many railroad bonds are "legal for investment" for certain funds and have therefore a demand in excess of their actual investment attractiveness; that is, they are purchased in preference to industrial or public utility issues of equal quality or of better income yield simply because the latter bonds cannot be purchased due to restrictions by law. On the other hand, bonds for which there is no specialized demand, or those issued by small companies, may sell far below their intrinsic worth giving a high yield. It is a fallacy, also to consider "listed" as more safe than "unlisted" bonds, and investors frequently pay through a smaller return for the privilege of seeing daily in the newspapers the records of transactions. In most cases "the market" for listed and unlisted bonds is exactly the same—the investment house sponsoring the issue—and it makes no difference if the dealings are published or not. The security is not improved nor does the listing of a bond create a market of itself.

In order to build up a satisfactory account, investors should analyze their individual requirements and make selections to conform to them Diversification in type, in maturity, in marketability and in geography will in most cases avoid risks and insure the maximum benefits of safety and income.

The Heavens in May

By Professor Henry Norris Russell, Ph. D.



At 11 o'clock: May 7.
At 10½ o'clock: May 15.
At 10 o'clock: May 22.

At 9 o'clock: June 7.
At 8½ o'clock: June 14.
At 8 o'clock. June 22.

At 9½ o'clock: May 30

The hours given are in Standard Time When local summer time is in effect, they must be made one hour later: 12 o'clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

The Heavens

THIS month, we find Saturn in the southeastern sky, just to the left of the star Gamma Librae (marked on our map) and a little below it The planet is so much brighter than the star that it will take a second glance to detect the latter

Perhaps an easier way to identify the planet is to look for it a little above the line joining the bright stars, Antares and Spica and much nearer the former.

Scorpio and Virgo are in the south Above them is Bootes, and below is Centaurus, whose brightest stars, pointing westward toward the Southern Cross, can be seen at this season from points within the tropics

Leo is in the west and Hydra in the southwest. Gemini and Auriga are setting in the northwest Ursa Major, Draco and Ursa Minor are high in the north. Cygnus and Lyra are in the northeast and Aquila in the east, with Hercules higher up and Ophiuchus in the southeast.

The Planets

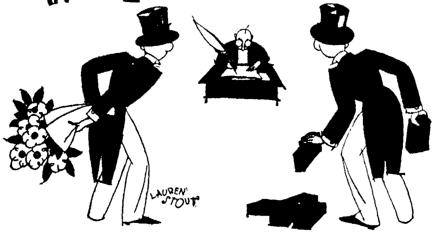
Mercury is a morning star all the month and is easily visible at its beginning, rising at about 4·15 A.M. He remains in sight till the middle of the month, and is then gradually lost from the observer's sight when dawn steals across the sky.

Venus is also a morning star, rising about 3 A M in the middle of the month and is very conspicuous. Mars rises much earlier —near 1 A M. at the beginning of the month —but still counts as a morning star Jupiter gets above the horizon about midnight and is conspicuous in the early morning. Saturn is in opposition on the 14th and is to be found as already described. Uranus rises about 2 A M and Neptune sets near 11 P.M., so that neither is very well placed for observation.

The moon is in her last quarter at 10 P.M. on the 4th, full at 6 P M. on the 11th in her first quarter at noon on the 19th, and full at 7 A M on the 27th. She is nearest the earth on the 7th, and farthest away on the 19th.

During the month she is in conjunction with Jupiter on the 5th, Mars on the 6th, Uranus and Venus on the 8th, Mercury on the 10th, Neptune on the 18th, and Saturn on the 26th.

IN THE EDITOR'S MAIL



Another Solution to the Grade Crossing Problem

We think that Mr. Ward has hit upon a very workable solution of an important problem. We happen to know that the same idea embodied in his letter is now in operation at one of the railroad crossings on the Long Island Railroad; and, in our opinion, it is such an excellent system that we wonder that it has not been installed at more crossings.

Scientific American,
Gentlemen:

I read your article in the August issue of the Scientific American entitled, "Saving the Motorist from Himself," and inviting the inventive minds of the country to help solve the problem.

I have been thinking over this since reading the article, and have figured out a device that appears to me to be feasible and yet not too expensive to install and keep up at all-important crossings.

The device consists of a storage battery placed at or near the crossings (within easy access of the highway or railroad employe who has charge of the installation and up-keep) connected by a wire running through water-proof conduits back from the crossings both on the highway and the railroads to a point about 500 feet with a switch under the railroad track so as to make a contact when a train is passing over it The lines extending along the highway should have red lights placed on posts, so as to be easily seen by the motorist when the lights are flashed on, either day or night. The lights should be spaced about 100 feet apart, along both sides of the highway, so that the motorist can not help but see them when they are flashed on.

The lights need not be large, but might be similar to the automobile headlight, only red instead of white.

A train approaching a crossing from either direction, when within 500 feet of the crossing would pass over the point of contact with the battery and immediately flash on the red lights along the highway on both sides of the crossing. The lights would remain on until the train was 500 feet beyond the crossing, or until the train had passed over the other point of contact.

The idea of having the lights extend back from the crossings 500 feet both on the highway and railroads is to give the motorist ample time to bring his car to a stop before reaching a crossing after the lights have been flashed on Should he be too near the crossing to do this when the lights are flashed on, he would probably have time to get past the crossing before the train reached it, as the train would be 500 feet away when the lights came on.

Then, farther back down the highway, signs could be placed, warning the motorist that he was approaching a railroad crossing.

No other signs of any description should be placed within this zone to detract the attention of the motorist from the crossing signs, unless it should be found necessary to place a road marker within the zone.

If 500 feet will not extend far enough back at crossings on railroads that run very fast trains, the point of contact could be placed far enough back from the crossing to make it safe

The cost of installation and up-keep of this type of crossing signal should not be prohibitive, and could be divided equally between the railroads and the highway department.

If this type of crossing signal were adopted as a standard the country over, the motorist would soon become familiar with it and would always know when he was approaching a railroad crossing, no matter in what part of the country he was traveling

The motorist from Washington or Oregon driving in Florida would be as familiar with the railroad crossings as he would be in his own state

W W Ward,
Dublin, Georgia.

A Correction

Some of the cares of an editor and an evidence of the possibility of making errors despite the utmost caution, is shown by the following:

Editor,
Scientific American

In an article of mine published in your March issue dealing with the peace uses of war gases, I note a rather unfortunate error The article gives the impression that CN and cyanogen chloride are the same thing, when as a matter of fact, the only property they have in common is that both will produce tears. CN is the abbreviation usually used to designate *chloro-aceto-phenone*

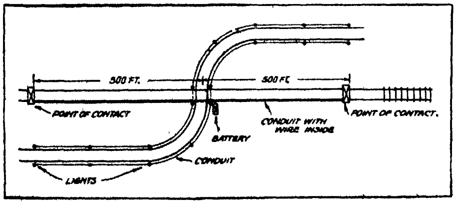
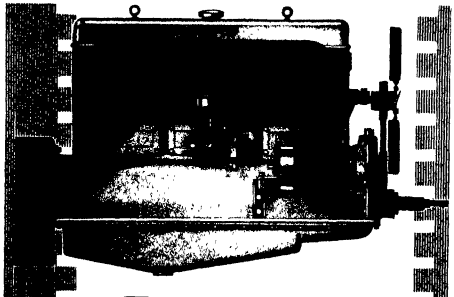


Diagram of lighting system for crossing signal



Easy on the Gas Tank!

WHERE profits depend much on ton-miles-per-gallon, Wisconsin's extra mileage on fuel and oil quickly climbs into a real money saving.

And these great motors *do* deliver this good measure. Their More Power per Cubic Inch is borne out day after day—by every model in the Wisconsin line of overhead-valve Fours and Sixes.

Wisconsin has taken the highly efficient overhead-valve principle and steadily refined and developed it—made it deliver more than it ever did before.

The facts are interesting and convincing. They will be sent gladly to any executive. Write—

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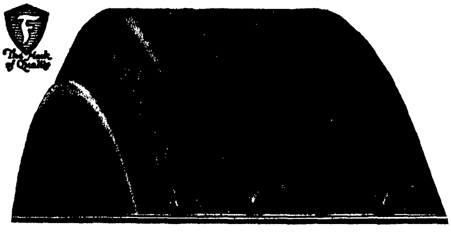
MILWAUKEE WISCONSIN

MORE POWER per CUBIC INCH

Wisconsin Motors are manufactured in a full line of Sixes and Fours, with power range from 20 to 120 H P—for trucks, busses, tractors and construction machinery.

Wisconsin CONSISTENT



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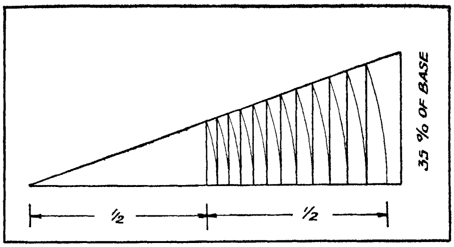


A simple method of working out the frets on a stringed instrument

which is widely used as a tear gas CN is a solid substance, and hence is easily handled in a variety of ways for producing tears Cyanogen chloride, on the other hand is a very volatile liquid which is quite difficult to handle It is produced in the United States Public Health Service method of fumigation by hydro cyanic acid by adding a small amount of bleaching powder to the sodium cyanide acid mixture used

The impression that I attempted to convey in the article in question was that there are many substances which can be used for the same purposes among the war gases, and that each of these has properties which make it particularly suitable for various uses

I trust that you will be willing to give space to the correction of this error.

Truly yours,
D H Killeffer

Out of Style

"It takes all kinds of people to make a world," and strange indeed are some of their ways We are under the impression that this peculiarly shaped head acquired by an old Indian tribe wouldn't go well with our modern fashion for bobbed hair—perhaps that's why this custom of the Clayoquets is no longer in vogue Our correspondent writes us thus:

Dear Editor:

The Clayoquots, an Indian tribe on the West Coast of Vancouver Island, British Columbia, were formerly distinguished by the unusual and artificial shape of their skulls During infancy a peculiar and unnatural elongation was produced by placing a board or cradle secured by cedar bark tapes on the head and allowing it to remain there until the desired conformation was obtained There appears to have been no mental impairment nor did the natives seem to be inconvenienced by their devotion to an extraordinary fashion. While the habit has been discontinued long since, our illustration of an elderly squaw—obtained with great difficulty at Quatsino village by Mr B. W Leeson (H M Canadian Customs)—gives an excellent idea of an ancient native custom

T. W S Parsons,
British Columbia

Is This an Original Method?

When strumming an instrument at some time you may have wondered how the frets were located Here is a very simple method.

Editor, Scientific American,
Dear Sir

I recently had occasion to lay out the frets on the fingerboards for some stringed instruments. After inquiring in a number of places and consulting the public library without results, I got out the old Physics book and figured out a method of laying these out to give the Chromatic Scale on any string.

The following is a description of the method which is easy and accurate and mathematically correct.

Lay out a right-angle triangle whose altitude is slightly less than 35 percent of the base (.349813 was the figure I obtained). From the acute angle, which represents the bridge, layout a distance equal to the length of the given string, with this length as a radius strike an arc cutting the hypothenuse, from this intersection drop a perpendicular to the base, this will be the location of the first fret. With this as a radius strike a second arc and perpendicular giving the location of the second fret. Continue to the twelfth fret which should fall exactly in the middle of the string It will, if the layout has been accurately made The second octave either above or below can be laid out by continuing in the same manner.

The angle was determined as follows:

The 1st fret = cosine $\angle X$
The 2nd fret = $(\text{cosine} \angle X)^2$
The 3rd fret = $(\text{cosine} \angle X)^3$

* * * *

The 12th fret = $(\text{cosine} \angle X)^{12}$

This also equals one-half the string, therefore $(\text{cosine} \angle X)^{12} = \frac{1}{2}$ or cosine $\angle X = \sqrt[12]{\frac{1}{2}}$ I found this to be .9437638, making the angle about 19°-18′-50″ The tangent of this angle gives the altitude of the triangle

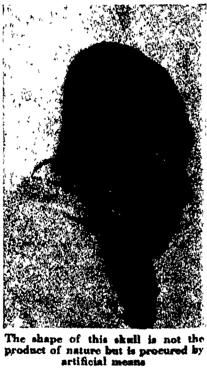
I made this layout on the polished surface of a bakelite panel using scratch lines and then transferred the locations to the fingerboard of the instrument

On the actual instrument the distance from the twelfth fret to the bridge must be slightly greater than that from the twelfth fret to the other end of the string as depressing the string increases the tension and the higher notes would be too sharp

J M Dockstader,
Perth Amboy, New Jersey

Let's Go!

From a prospector "in the bush," as they say in Australia, comes a letter which is of interest in that it gives us not merely an insight into the rather unusual underground quest for the beautiful black opal, but an insight into the thoughts of a reader in the antipodean continent which lies "down under" The writer wants our readers to



The shape of this skull is not the product of nature but is procured by artificial means

pack up and leave for a prospecting trip in New South Wales.

It is curious how few people have seen an opal. The man in the street considers it unlucky, but to the opal miner it is unlucky only when he has none in his possession. Most people are under the impression that the diamond is the most costly precious stone, but a "dinkum" black opal will bring many times the price per carat of the finest diamond; and those who have seen the magnificent display of colors in an opal gem will agree that it far surpasses all other precious stones in loveliness.

The finest class of opal is the black opal, which has a black background, and shows beautiful red, green, orange or blue flashes, or a combination of these, *in fact all the colors of the spectrum.* Lightning Ridge is world-famous for its black opals.

The geological features of Lightning Ridge are very interesting There is on the surface, which is much eroded, a thin layer of weathered conglomerate with rounded quartz pebbles reminiscent of an old sea beach. This layer is nowhere more than a few feet thick, and in many places is totally removed. Beneath this comes a stratum of fireclay, baked like the "biscuit" of porcelain, and varying from a few feet to eighty feet in depth This stratum has been subjected to considerable heat, and overlies a stratum of red sandstone about ten feet thick. Under this sandstone is a remarkable, thin layer of very hard sandstone, called by the miners "steelband" because of its hardness. This layer is very thin, and in some places is missing Its greatest thickness is about five inches, except in folds and contortions which it often shows The next stratum below the "steelband" is also a fireclay which varies in thickness.

The opal is found in the "steelband" and in the foot or two of fireclay below it. It seems as if the solutions carrying the silica of the opal had come down through the sandstone at points or cracks, and formed the "steelband" in irregular layers between the standstone and the fireclay below it, saturating also the clay for a foot or two in depth, and forming "nobbies" or chunks of opal in both. It is well known that a layer of basalt produced by volcanic action once overlay this country. This basalt probably supplied the heated solutions which produced the effects visible in these beds of clay and sandstone Red iron oxide is in evidence almost everywhere.

It must not be imagined that opal occurs always as clear gemstones The gemstone free from sand is the exception, which accounts for the rarity and costliness of black opals Then also, black opal occurs in large knobs which show no color, and are therefore valueless. It is heartbreaking to see stones worth hundreds of pounds ruined by sand inclusions. Such stones often show the most beautiful flashes of red and green, but the stone when faced shows sand and dirt, which spoil its appearance

The equipment necessary for mining is extremely simple Just a windlass and buckets and picks and shovels complete the gear A house in this beautiful climate needs only a roof The sides are better open The air is like wine, and the cost of living low Opal mining offers the best prospecting chances in the world, for, at least, you can always make the cost of your "tucker," and there is a chance of a strike worth thousands of pounds Strikes up to ten thousand *have been made on this field from* single claims one hundred feet square.

If you have never seen black opals I counsel you to visit your jeweller forthwith For as Ella Wheeler Wilcox has it, the gem is a child of the marriage of the sunbeam and the moonbeam, a thing of surpassing loveliness

M S B
Lightning Ridge,
New South Wales

A Splendid Antidote for "Blue Monday"

The letter herewith has given us particular joy—because it comes from a "brother in the trade" From experience he knows some of the problems which an editor has to work out in an effort to put into the hands of his

Where quantities of black opals are mined

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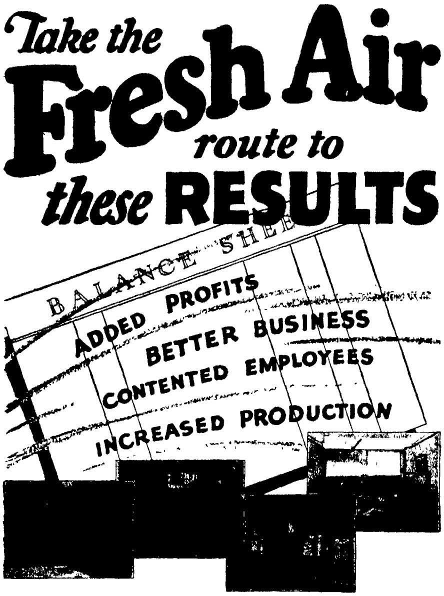

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readers a magazine which is attractive, not only from a standpoint of interesting reading matter, but also from a standpoint of arrangement of material, pleasing and informative illustrations, easily read type, and so forth Thank you, Mr Gage!

Editor Scientific American, (the Make-up Editor in particular)

I have just finished reading the December issue of your always-welcome publication, and feel moved to strongly endorse what Edward N. Lake wrote you, as printed on page 429.

It *is* much more satisfactory to the reader of your pages not to be obliged to "skip all over the lot" to get the whole of an article, yet your advertisers do not need to feel that they are thereby in any wise handicapped, for you very skilfully keep up the interest all through the publication, and one page is as good as *another*.

I am a printer of over forty years' experience, so can appreciate the tremendous amount of work involved (including the intelligent use of the blue pencil) in making your contributed articles "come out" just page length. But the effect is *fine*.

I make no claim to being "scientific" in any sense of the word, but the fine discernment shown in making scientific articles easy of comprehension to the lay mind, (such as "Plating Rubber" for instance) gives your publication, with its acknowledged voice of authority, a most unique position among the publications which come into our home—29 of them every month

Years ago, the old form of the Scientific American while in some degree interesting, made reading its pages more or less of a task In your present form it becomes a pleasureable delight

One other matter—purely technical I readily appreciate why you do not use enameled paper on the publication, but believe you might select a stock which would print your halftones better, and yield more detail As an instance, the "open safety pin" in the plate at top of page 381. In *my* copy the safety pin is hardly discernible I believe there is more detail in the plate than shows

At any rate, I have "got it off my chest" and will close by giving you my hearty congratulations on the exceedingly high-class publication you are putting out.

Fred W. Gage,
Battle Creek, Michigan.

Adventurous Birds!

From one of our Scottish readers, Mr. E. O Catford, of 6 Royston Terrace, Edinburgh, comes an interesting item.

It seems that high on the "hooter" of the Edinburgh Corporation Tramways Depot a sparrow built her nest and laid in it three eggs, to the accompaniment of loud "hoots" which sounded forth from the horn four times daily In fact, one of the young birds fell out of the nest when the hooter was sounded one day. The other two were successfully reared, and—we should imagine—they must be so immune to noises that they could live quite happily amid the nerve-wracking noises of New York.

Our photograph shows the hooter and the nest. The wooden shelter which ordinarily protects the horn from rain was removed in the interests of a good photograph.

The Traffic Problem in Remote Siam

Evidently we're not the only nation concerned with traffic problems. This letter from Allen Bassett of the Prince Royal's College at Siam, describes a method put into practice there in an attempt to diminish the number of accidents:

Chiengmai, Siam.

Editor,
Scientific American:

Your article on "Saving the Motorist," by H. W. Slauson, was of keen interest to me as just now, because of the increasing number of motor accidents here, we are experimenting with means to save him and his victims.

The device that sounds so simple that it was laughed at when presented has gone a long way toward solving the problem.

The method used is simply to put strips of raised paving (about two feet wide and curving to a height of ten or twelve inches in the center) at intervals across the road approaching a danger point. These strips may be negotiated only at slow speeds with comfort and give an absolutely inescapable warning of danger ahead.

They have proved so effective in Siam that the accidents have been diminished by more than 80 per cent

Allen Bassett.

Tradition

What a mighty thing is a long honorable record! How this appears from both sides is shown by the following letter:

Scientific American
Gentlemen

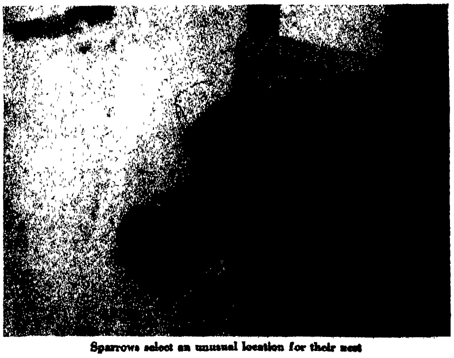
I have been a reader of the Scientific American for some 40 years I recently saw a page from the Scientific American of the year 1872, illustrating and describing the Bradley Cushioned Power Hammer which we put on the market that year, and which we still make and market.

I haven't a doubt but what my father and grandfather were subscribers to and readers of the Scientific American from its birth in 1845 Our business was established here in 1832

I know that I have read it for more than 40 years, in fact it is the first paper or magazine I remember My boys read it now and no doubt my grandchildren will some day, in case they are boys.

Wishing every, and continued, success, I am,

Yours respectfully,
C. C. Bradley, Jr., President,
C. C. Bradley & Son, Inc.



Sparrows select an unusual location for their nest

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Kadel & Herbert

The heart of WHAP, New York. This is the Manhattan station which bans jazz, advertising and propaganda from its microphone. The wavelength is 240 meters

Observations Show Aurora Blameless

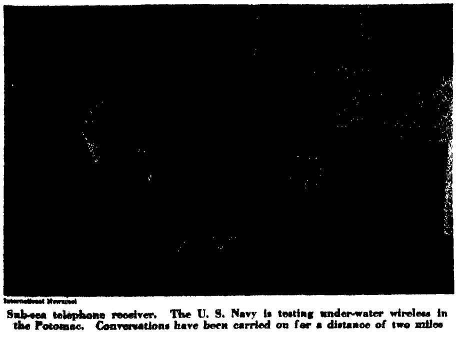
IT is a question whether or not the aurora borealis has an ill effect upon radio. Observations to date, however, indicate that the Northern Lights are not a disturbing factor so far as radio is concerned. The effect upon very short waves is not fully determined.

During this year's international broadcasting tests there was an aurora borealis phenomenon which interfered with telegraph traffic. The earth currents picked up by the wires reached a potential as high as 150 volts. The disturbance was chiefly noticeable on grounded circuits, but the full metallic long-distance telegraph and telephone lines which had no connection with the earth did not pick up the strange current.

The northern display apparently has a peculiar effect upon waves under 100 meters in length, but not upon the higher waves. During the January aurora, commercial short-wave stations could not communicate across the Atlantic. Everything seemed to go "dead." Low wave receivers in England failed to detect the 41 meter signals from WGY as on the two previous nights. The British authorities, however, scarcely felt that the aurora was affecting the regular broadcasting channels from 200 to 550 meters, because they could not hear the transmitters in the United States on the other nights of the test when the aurora was not visible.

The statement that "auroral phenomena acts like a blotter on the air, it mops up everything," is contrary to conclusions reached by experts who have made a study of the aurora and its effect upon Hertzian waves.

Dr Donald B MacMillan, who made it a point to study the aurora and radio in the Far North, came back from an arctic expedition in September, 1924 and said, "The aurora borealis apparently has no effect on radio transmission or reception. We even passed right through the aurora belt and it did not trouble the radio waves



International Newsreel

Sub-sea telephone receiver. The U. S. Navy is testing under-water wireless in the Potomac. Conversations have been carried on for a distance of two miles

"The little wrinkle that makes my 'B' batteries last longer is using the right size Eveready with a 'C' battery"

"I USED to think that because the Eveready 'B' Battery No. 772 cost less than either of the larger Heavy Duty Evereadys that I was saving money. As a matter of fact, on four or five tube sets, that was false economy.

"The right size Eveready 'B' Batteries to use depends on the number of tubes in your set. The life of the batteries depends on how much you listen in and on whether a 'C' battery is employed."

To get the maximum of "B" battery life and satisfaction, follow these simple rules.

On 1 to 3 tubes—Use Eveready No. 772.

On 4 or more tubes—Use the Heavy Duty "B" Batteries, either No 770, or the even longer-lived Eveready Layerbilt No. 486.

On all but single tube sets—Use a "C" battery.*

*NOTE. A "C" battery greatly increases the life of your "B" batteries and gives a quality of reception unobtainable without it. Radio sets may easily be changed to permit the use of a "C" battery by any competent radio service man.

Follow these rules and No. 772, on 1 to 3 tube sets, will last a year or more; Heavy Duties, on sets of 4 or more tubes, eight months or longer.

The average year-round use of a set is two hours a day. If you listen longer your "B" batteries will have a somewhat shorter life. If you listen less they will last just that much longer.

Our new booklet, "Choosing and Using the Right Radio Batteries," is free for the asking. It also tells about the proper battery equipment for the new power tubes.

Manufactured and guaranteed by

NATIONAL CARBON CO., INC.
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Canadian National Carbon Co., Limited
Toronto, Ontario

Tuesday night means Eveready Hour—9 P. M. Eastern Standard Time, through the following stations

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WEEI *Boston*
WTAG *Worcester*
WFI-*Philadelphia*
WGR-*Buffalo*
WCAE *Pittsburgh*
WSAI-*Cincinnati*
WTAR *Cleveland*
WWJ-*Detroit*
WGN-*Chicago*
WOC-*Davenport*
WCCO *Minneapolis St Paul*
KSD *St Louis*

LEFT No. 486 *for 4, 5 or more tubes* $5.50

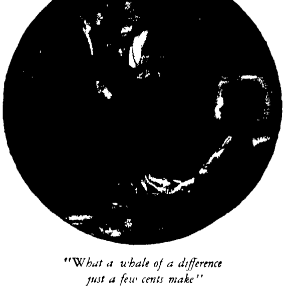
RIGHT — *Eveready Dry Cell Radio "A" Battery, 1½ volts*

EVEREADY
Radio Batteries
-they last longer

As it should be

SINCE its extra cost, when spread over its billions of output, figures to but three cents per package of twenty, it is quite fair to say that Fatima, in between 'costly' and 'popular' in price, is decidedly more popular than costly

FATIMA



"What a whale of a difference just a few cents make"

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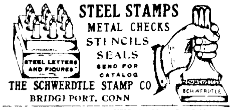

YOU'LL wonder how such power and pep can be packed into so tidy a bundle! Flexifour is wonderfully compact—yet very accessible—easy to care for New 1926 refinements, coming on the heels of its 1925 gain of 25% more power on 10% less fuel, make Flexifour HANDIER, simpler, smoother, surer to start and run. Get the facts and figures! Mention size of your craft

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DEALERS: Write for proposition

Robt H. Ingersoll, Pres. New Era Mfg Co.
Dept. 865 476 Broadway, New York City

International Newsreel

The ear of under-sea wireless. Dr. E. B. Stephenson, physicist of the Naval research laboratories, lowering the sound detector into the waters of the Potomac

in the least After we passed through the aurora belt the display was no longer northern lights, but a southern light"

Reports from wireless operators at ship and shore stations substantiate MacMillan's statement Spectacular displays of the aurora in 1919 completely crippled Canadian and New England telegraph lines, but radio operators on ships off the New England coast and the shore stations noticed no bad effects

Heaven-wide displays over Lakes Superior and Huron in 1917 were so strong that they waved back and forth across the sky and reflected on the water like moonlight, but the range of transmission and reception by radio on the Great Lakes was not affected, nor did the waving curtains of varicolored light stir up an increased amount of static

Canadian Amateurs on 52.51 Meters

WEDNESDAY evening is set aside by Canadian amateurs for the free exchange of trans Canada traffic on a wave that is assigned to bring all amateurs together. During the winter of 1924-25, the 120 meter wave was used When the Canadian amateurs convened in Montreal at the American Radio Relay League convention in November, they petitioned the Government for a new wave band nearer to the amateur short-wave channels In response to this request they have been assigned the 52.51 meter channel

In order to be sure that all wave meters and transmitters are properly calibrated, the Government broadcast tests on the 52.51-meter wave from Ottawa

Likes and Dislikes of Radio Fans

INTERESTING facts regarding the likes and dislikes of the radio audience were revealed in the answers to 4,000 questionnaires circulated by the management of station WJZ among listeners, who wrote to that station reporting on the reception of the 50 kilowatt transmitter at Bound Brook, New Jersey The object of the questionnaire was to obtain information useful to the impresario in planning programs

Courtesy of the General Electric Company

A piece of quartz crystal less than an inch square, ground to a thickness a shade less than an eighth of an inch, controls the frequency of WGY's 50-kilowatt transmitter. There is not a fractional departure from the assigned wavelength. At the left is the crystal amplifier, which houses the quartz crystal and the exciting tube. At the right is a stage of intermediate amplification. The engineer is holding the quartz crystal and the metallic chamber in which it is enclosed

Classical music was 33 percent more popular than jazz.

More than three times as many reported that they used outdoor antennas as those who use antennas inside the home

The answers revealed that orchestral music is the most popular, with bands, symphonies, violin, organ and piano following in order Vocal quartets are far more popular than vocal trios In the vocal solo field the contralto received the majority of votes, with soprano second and bass third.

In the service end of the broadcasts, news led by more than 25 percent. Time signals and sports ranked second and third respectively. Stock reports were fourth, road conditions, fifth, and agricultural information, sixth.

Baseball led as the most popular sports broadcast in the United States Baseball was 10 percent higher than football, which ranked second The Canadian questionnaires placed hockey first, horse racing second and baseball third.

Travelogues ranked far ahead in the field of talks Scientific topics were second, with other subjects voted for as follows politics, health, literature economics, art, debate, forum and beauty

Few objected to programs sponsored for good will publicity, and the majority who voted for this type of program justified their vote by explaining that entertainment promoted by advertisers improves the quality of the broadcasts

In answer to a question regarding interference, there was an overwhelming complaint against radiating receivers, which act as miniature transmitters and annoy neighbors

The questionnaires clearly show that male announcers are preferable to women announcers The general complaint directed to announcers was that they did not give the station's call frequently enough Other suggestions regarding announcers was that they stop trying to be funny, be brief and stop broadcasting lengthy descriptions of selections and the life story of the composer

Church services on Sunday won the praise of many who answered the questions Quite a number specified their religion but did not express a desire for any particular denominational service on the radio

Most of the listeners reported that their homes are wired for electricity and that they are lighted by 110 volt, 60-cycle alternating current Those who reported on direct current were in the minority

Stimulating Sales of "B" Eliminators

THE Potomac Electric Power Company of Washington, D C, is offering "B" battery eliminators on a cash payment basis as an inducement to radio set owners to purchase the current supply devices The payments are added to the monthly electric light bills

The Electric Company has adopted the slogan, "Run your radio from your house current." The devices cost about fifty dollars They enable the radio listener to use the house-lighting current instead of batteries

Arc Discontinued

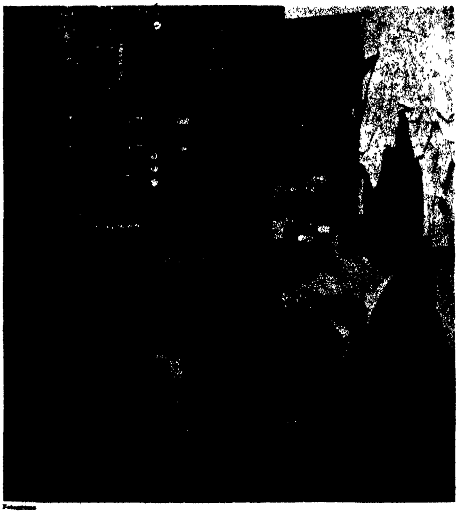
THE 30-kilowatt arc transmitter at the Great Lakes Naval Training Station has been discontinued because broadcast listeners complained of interference created by the arc Traffic from the Great Lakes Station is now being handled on 34 meters

Underground Wires Make Good Aerials

PAPERS prepared by Commander A Hoyt Taylor of the United States Navy Radio Research Bureau and Lieutenant A Crossley, appearing in the proceedings of the Institute of Radio Engineers explain some of the results obtained with underground antennas

The navy men said, "It has been shown that it is possible to receive efficiently signals from stations at any wavelength, long or short, using submerged or subterranean wires provided that one or more stages of amplification are used

"The relative advantage of ground-wire reception on short waves lies in the ability



[illegible]

Two microphones, to aid the deaf, are placed on the stage of the Guild Theatre, New York, to pick up the words of the actors and forward them to the amplifying equipment in the basement. Wires lead to a row of seats where plugs are located with earphones. A small control is placed at the side of each seat, so that each person can regulate the volume

"It's So—
But D—— If I'll Believe It!"

"WHEN they installed those bearings twenty years ago, they said they didn't need any oil. I've been waiting every day to see 'em burn up. But they ain't done it yet."

Do you believe that any bearing can run for 20 years without a drop of oil? Do you believe you can buy a bearing like that for one-sixth the price of bronze?

If you don't believe it, we can't blame you. But there is such a bearing. It is called the Arguto Oilless. And if you care to be convinced—just drop us a line.

Actual experience shows that Arguto Oilless Bearings effect a 300% increase in the life of a power belt—prevent slipping and eliminate belt dressing as well as the labor of applying it.

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AN OPEN REPORT

SCIENTIFIC AMERICAN
Woolworth Building
New York

Mr. Orson D. Munn,
Editor Scientific American.

My dear Mr. Munn:-

We are pleased to report that Mr. Porter's recent articles on "Telescope Making" and Mr Ellington's "More Houses of Mud" have produced an unprecedented sale for Amateur Telescope Making and Modern Pisé Building

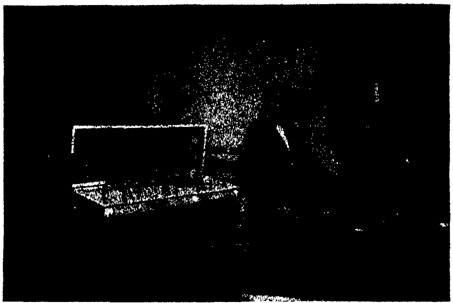
The orders for these books reached us in such volume that it was necessary to employ additional help to take care of them While there has been some delay in getting the orders out, we have now about cleared matters up

This will help to explain any complaints that may reach your desk

By your instructions we have priced Amateur Telescope Making at $2 00 postpaid and Modern Pisé Building at $2 65 postpaid.

Respectfully,

BOOK DEPARTMENT.



Harris & Ewing—Wide World

Experimenting with vacuum tubes. This vacuum tube pump belongs to the Bureau of Standards, and is employed for discharging air and gases from the bulbs

of the receiving operators to continue to copy messages through violent electrical storms without danger to themselves and with little or no interruption of traffic

"Reception in fresh water or wet soil is superior to that of bare wires above or on the surface or in dry soil As the wire is lowered into the water or into the wet ground, the signals increase Ground wires have a high degree of directivity which can be utilized for shutting out interference from a neighboring source Static is minimized."

Radio Has Won Noted Artists

RADIO during the past winter season won many noted artists to the microphone, prominent among them Schumann-Heink, John McCormack, Lucrezia Bori, Mary Garden, Louise Homer and Charles Hackett All seem to have been attracted to the radio studios under the auspices of advertisers Thus, the desire to get the name of a firm or product known has greatly improved the quality of radio entertainment

Mme Louise Homer was asked whether artists missed the applause they are accustomed to receive from concert stage audiences

"Yes and no," answered the prima donna. "The hall may be filled with a storm of applause, but the artist alone knows whether it is deserved; and if not, for one reason or another, he is very conscious of it.

"Praise is dear to all of us, whether we are singers or ditch diggers, but if we ourselves do not know whether the praise is merited we shall never be able to accomplish very much that is worth while, whether it is singing an opera or digging a ditch. Even when outbursts of applause are later supplemented by the choicest adjectives of newspaper critics, I know whether it is deserved"

There have also been many leading bands and orchestras on the air during the past season. Outstanding among them has been Henry Hadley's Philharmonic, which won considerable applause and caused much favorable comment among radio fans The Philharmonic playing the "Angelus," composed by Mr Hadley, was one of the bright spots of the 1925-26 radio season.

Nine Argentine Stations

TWO more broadcasting stations are radiating into the air of the Argentine Both are located near Buenos Aires and the power output of each is 1,000 watts One uses the call LOT and the other LOO The former broadcasts on 272 7 meters and the latter on 250 meters Buenos Aires now has nine radiophone stations

Prefer Farm Talks at Noon

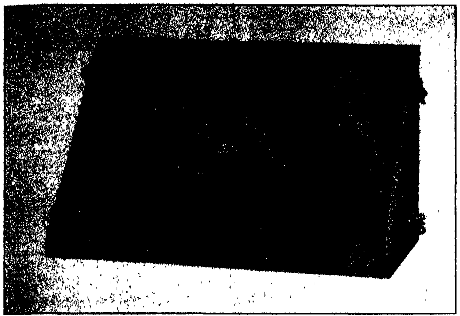
A NUMBER of farmers have asked the Department of Agriculture to broadcast the agricultural reports from WRC and WCAP, Washington, at noon instead of at 7 P M It is argued that such information received at noon would be most helpful to the farmers, and furthermore, it would not break into the entertainment which city listeners tune for early in the evening.

Says Future Plays Will Be on Radio

COSMO HAMILTON, who is doing much to develop the radio novel, recently said, "I think that radio will be used by dramatists long after the theatre as an institution has

Harris & Ewing—Wide World

The laboratory of the Bureau of Standards has designed and built an apparatus whereby the wavelengths of radiophone stations may be measured to determine if they are on their exact wave channels


Kadel & Herbert
The new Marconi short-wave receiver for wavelengths from 15 to 100 meters

been shut up, and the shutting up of the theatre is undoubtedly a fact which we shall have to face

"The experienced dramatist who has been in the habit of writing himself into three acts will have to reconstruct his technique and write himself into one act and then write himself down finally into fifteen minutes I believe that half the dramatists of the day are retiring because they cannot compete with the changes that are going on in the theatre The thing we are striving for is a concise form of writing—the elimination of every unnecessary word"

Radio Workshop Aids Parts Business

AMERICAN stores may find a good suggestion in the radio workshop installed in the Selfridge and Company store in London There, radio fans can build their own radio sets under the guidance of an experienced radio electrician The system has been named "Wireless without Tears"

The workshop is open daily except Saturday in two sessions, from two to four o'clock and from four to six o'clock Tickets for admission are obtainable from the radio department of the store There is no charge for the service.

Canadians Organize

CANADIAN radiophone stations have joined in a new organization known as the Canadian Association of Broadcasters The announced purpose of the association is to improve the standard of broadcasting, to promote the interests of the broadcast auditors, and to spread by means of radio a wider knowledge of Canada, its advantages and opportunities

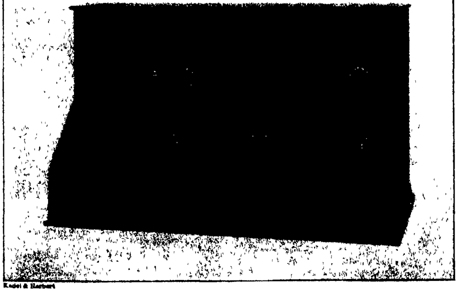
The organization was prompted by the insistence of the music copyright owners that the broadcasters should take out licenses from them and pay license fees J N Cartier, of station CKAC is president of the association

Strive to Improve Expositions

NEW YORK has an unfortunate situation so far as radio shows are concerned Two factions, one representing New York interests and the other controlled by Chicago interests staged two shows on Manhattan Island last September, and both were in progress at the same time One show would have been enough Comment heard among radio fans after the expositions last autumn showed that the consensus of opinion was that it would be the best thing for the radio industry if the two show factions would bury the hatchet and come to an agreement whereby one big show of concentrated effort could be held in New York under one roof, thereby eliminating duplication of effort on the part of the exhibitors

Present plans call for two New York shows in September again this year one at the Grand Central Palace and the other at the new Madison Square Garden

A radio exhibition corporation has been organized by several leading manufacturers to make a general study of the radio show


Kadel & Herbert
The Marconi general utility receiver, type RG5, comprising amplifying detector, low-frequency magnifier, aerial tuning circuit unit, and closed circuit tuning unit. It was designed to meet the requirements of those who need an efficient and selective receiver to cover an extremely wide range of wavelengths with the simplest possible adjustments. Three hundred to 30,000 meters can be manipulated by the veriest novice

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Terrific shocks and knocks will not put them out-of-round. Super-strength and light weight make them the ideal wheels for the trailer.

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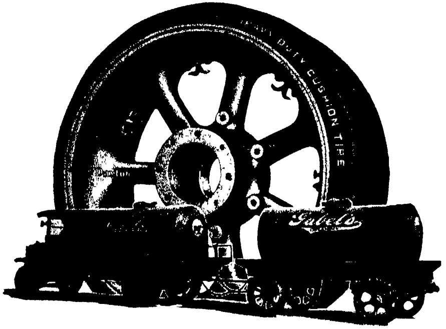

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1924 was a wonderful Binocular year 1925 still bigger 1926 will be biggest of all Select glass you prefer and have us send it on 10 days trial No obligation Write for free catalog Postal will do

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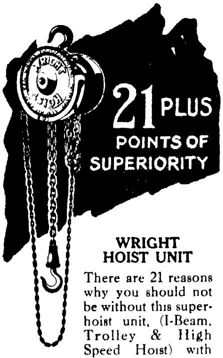
Geneva, New York



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Let us tell you about each one?

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Harris & Ewing—Wide World

Testing radio coils. This is the laboratory of the Bureau of Standards in which answers are found for the many questions asked about the various types of coils used as tuners in receiving sets

situation, especially in New York It is understood that the exhibition corporation will strive to have only one show in New York

R M Klein General Manager for F A D Andrea Inc , announced the general purpose of the association The general object is to insure radio shows that will be put on in a manner to bring the greatest benefit to the public to the radio manufacturers and to all elements having the best interests of the radio industry at heart Promoting shows for the benefit of an individual or group of individuals will be discouraged The public is entitled to first consideration in this matter "

Most Stations Operate on Low Waves

The majority of broadcasting stations in the United States are operating on wavelengths between 205 and 278 meters On wavelengths above 278 there are not more than four stations with the same wavelength

The 275 meter channel is the most congested It has 26 stations There are 24 transmitters on the 250 meter wave, 23, on 278, 19 on 253 and there are 15 stations on each of the following waves 225, 231, 234 242 and 248

Fifteen stations are rated with power outputs of 5 000 watts and higher Seven stations have exclusive wavelengths, and out of the seven two have outputs of 5,000 watts or more four are between 500 and 5,000 watts and one is under 500 watts The majority of transmitters are rated at 500 watts or less

British Audience Growing Fast

Radio set owners in the British Isles now total approximately 2 000 000 During the past year the number has grown at the rate of about 50 000 a month

Weather Man Shy of Static Forecast

The weather man is shy of forecasting static or radio atmospheric conditions The United States Weather Bureau has been asked to undertake forecasts pertaining to radio reception a night or two in advance—that is, whether reception would likely be poor, fair good or excellent But the officials of the Bureau contend that the relation between radio reception and meteorological conditions is too indefinitely established and too many other variable factors are involved to justify a service which would necessarily be uncertain

Professor C F Marvin, Chief of the Weather Bureau when asked why the Government could not issue a daily radio forecast said, "I feel it would be unwise to attempt a new work of this sort in a hit-and-miss way and that we should not do so until the subject has been investigated thoroughly and systematically and we are convinced a worth-while service can be given There are so many factors involved and so little definite data available that it would require an extensive program of collecting and compiling data before a serious study of the problem could be made "

A Freak Blanket

A "magnetic blanket" is blamed for poor radio reception during the past winter At times the "blanket" seemed to lift and let the Hertzian waves travel longer distances, but in general it suffocated the waves The winter of 1925 26 will go down in history as one of the worst seasons of radio reception

Cage Aerial Improves WOR

Station WOR is now using a six wire cage aerial instead of an eight wire flat top aerial, with the result that the radiation has increased from $6\frac{1}{2}$ amperes to $9\frac{1}{2}$ amperes The lead in is also built in the form of a cage The aerial proper is insulated by two two-foot glass insulators

Seventeen Stations in WEAF'S Network

Gradually WEAF's radio network is expanding, and it now totals sixteen broadcasters connected with the New York microphone by land wires These allied transmitters are WEAF, New York, WEEI, Boston, WTAG, Worcester, WJAR, Providence, WFI, Philadelphia, WOO, Philadelphia; WCAE, Pittsburgh, WCAP, Washington; WGR Buffalo, WWJ, Detroit, WSAI, Cincinnati, KSD, St. Louis, WLIB, Elgin; WGN, Chicago, WCCO, Minneapolis; WEAR, Cleveland; WOC, Davenport The stations at Elgin, Illinois, and WGN, Chicago, alternate in taking the programs from New York, and the same is true in the case of the two Philadelphia stations There are eighteen transmitters in the chain, but the alternate broadcasting makes the maximum tie up sixteen It is probable that more stations will be added in the future

Radio Pianos Tuned Regularly

There are numerous aspects of broadcasting which rarely come to the attention of broadcast listeners, but which are important factors in the enjoyment and reception of the programs The four pianos of WEAF are tuned regularly on Saturday their tone is regulated once a month and constant vigilance exercised as to pitch. After a year's service they are returned to the factory for a thorough overhauling The pianos at this Broadway station are used on an average of thirty hours a week

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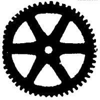

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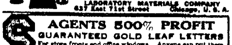

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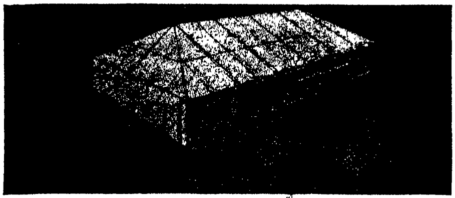


A huge portable hangar for airplanes

A Portable Hangar

A PERMANENT airplane hangar may cost anywhere from $15,000 to $40,000 This constitutes an important initial outlay for an air transport company, particularly in the experimental stages of its existence It has therefore been frequently suggested that cheap portable hangars might be useful under such circumstances

An interesting type of portable hangar has now been designed by the Spalding Construction Company The hangar has a center ridge to form a well pitched roof There are sixty foot wide doors with cables to support the door curtains The ridge is carried on poles far enough apart for planes inside the hangar to pass between them A double set of guys is used, one independent of the canvas and the other attached to it

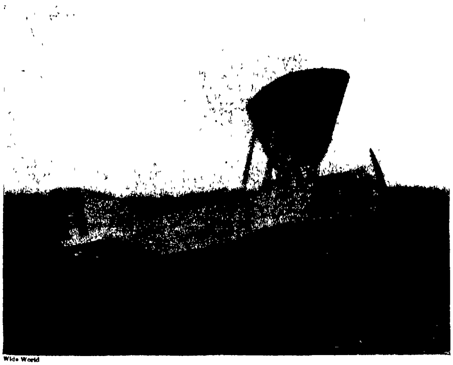
With care such a canvas hangar could ride out a 100-mile-an hour wind The canvas hangar can be safely heated with oil stoves and ample daylight is admitted through the walls It is curious to what size and engineering form the simple canvas tent has grown!

Altitude Flying

LIEUTENANT MACREADY is trying hard to regain the world's altitude record, which the Army Air Service lost to the French aviation service The altitude record has more than a sporting significance To win in aerial combat, the safest principle is to get "on top" of the enemy and to dive rapidly on him in attack The aviator whose plane has the greater "ceiling" is therefore likely to win

In altitude flight, many technical problems are involved, the securing of large lift in the wing, and the employment of the supercharger to maintain the power of the motor at great heights among many others

But perhaps the most fascinating part of the altitude climb is the effect on the pilot He must combat cold, lack of oxygen and lack of air pressure On February 22, 1924, when Macready flew to 35,000 feet, a tem-



Wide World

This illustration shows a special Army Air Service plane in which Lieutenant John A. Macready reached a height of 37,579 feet. The world's record is 39,586 feet. At the side of the engine is shown a new gear-driven super-charger. At high altitudes, the air has so low a density that the power of the motor falls off very quickly. The super-charger compresses the rare air before it is delivered to the motor. It was a mechanical failure in this super-charger that prevented Macready from reaching his goal which was 40,000 feet. Certain other features are embodied in the design of a plane for high altitudes. A heavily cambered or thick wing is employed, giving a great deal of lift. For the same reason the wings are set far apart, giving the machine a somewhat topheavy appearance. The wings are also given a large ratio of length to chord or width, which also helps in the climb. A deep fuselage is employed in which the pilot sits well sheltered from the wind

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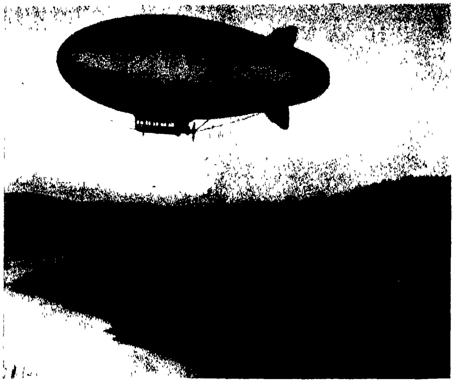

Courtesy of Society of Automotive Engineers

The metal-clad MC-2 as it will appear in the air. The short, stubby form has proved more efficient aerodynamically than the conventional elongated airship forms

perature of 83 degrees below zero, Fahrenheit, was recorded

To date the element of cold is most easily combated Heavy underwear, a leather flying suit, thickly padded with down and feathers, headgear lined with fur, and goggles, coated with anti-freezing gelatin, provide ample protection, in conjunction with air heated by the motor exhaust

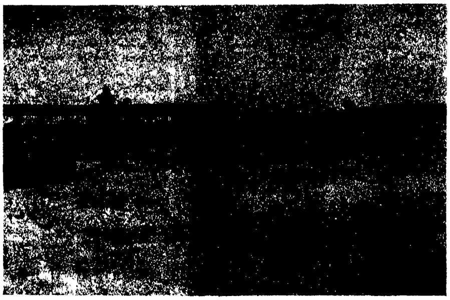
Lack of oxygen and lack of pressure are much more difficult to withstand Most pilots must begin taking oxygen around 16,000 or 17,000 feet, using more and more as they ascend At extreme altitudes, say 30,000 feet, the difficulties are even greater It seems to make no difference how much oxygen the pilot consumes, because at the low pressure of one fifth of normal atmospheric conditions, he seems unable to assimilate either air or oxygen in the great volumes required to compensate for the low pressure and density This is where the pilot must watch himself The least movement of his arms or any part of his person causes a need for more oxygen and induces light headedness Absolute immobility becomes imperative The pilot must even be relieved of the slight movements required in recording data and all instruments must be self recording in such adventurous flights

A Metal-clad Airship

THE rigid airship as constructed today has an outer covering of rubberized cotton, and inner gas bags of gold beaters skin There is no doubt that the use of fabric has many drawbacks It is not fireproof, it is not weatherproof, it is not durable, and while the gold-beaters skin is an excellent material in preventing leakage of gas, it is expensive and difficult to handle Accordingly several years ago an organization was formed under the auspices of many prominent automotive men to develop a metal clad airship which should be free from these defects

Automatic riveting machine in operation

In an interesting paper before the Society of Automotive Engineers, Ralph H Upson summarizes the results of many years patient and intelligent experimentation in this direction, which have been embodied mainly in


In the Red Lake gold Rush at Hudson on the northern transcontinental line of the Canadian National Railways the primitive and modern transportation facilities meet. It is 150 miles from Hudson to Red Lake and takes from 6 to 12 days by dog team. Airplanes make it in less than two hours

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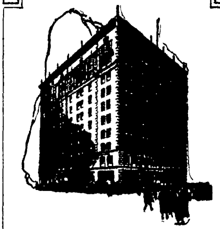

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An Army Air Service training plane in which snow skids have been substituted for the customary wheels

the design (but not yet the construction) of a 200,000 cubic feet airship, the *MC 2*

The hull of the proposed airship is to be entirely of metal except for an internal fabric diaphragm which provides the ballonet or air control chamber always found on the more conventional types of non rigid and semi rigid airships The design of the hull offered some exceedingly difficult problems in mechanical construction The art of rolling a very long and wide duralumin sheet of only 8/1000 of an inch in thickness was painfully developed Then arose the question of making the joints in the thin metal gas tight This was accomplished by an intensive study of the homely gasometer Spacing of rivets and other dimensions at the joint were tried which were the reproduction of a gasometer on a small scale With the aid of a special seam dope, surprising results in gas-tightness were achieved, the gas leakage was only one tenth of that of gold-beaters skin, which had so far surpassed all other material in permeability

There still remained the problem of dealing with the immense number of tiny rivets required In the comparatively small *MC 2*, 3,000,000 small rivets would be required The difficulty was finally solved by the design of an automatic riveting machine which drives 5,000 rivets an hour, takes care of its own spacing and does the work infinitely better than it could be done by hand

Fatigue and vibration tests on both the covering and the joints proved satisfactory

Would the metal covering, granted that tightness and riveting problems were solved, prove so heavy as to be impractical? The *metal sheet, while less than one-third* as thick as the fabric was four times as heavy per square foot Nevertheless, the most careful calculations applied to an airship of the size of the *Shenandoah* showed that the metal clad airship would have a far lighter structure than the rigidly trussed, fabric covered dirigible of the conventional type!

Considered as a cover, the metal sheeting serves the same purpose as the conventional, fabric outer cover, but by eliminating the flapping and moisture absorption so common to fabric, it does it more efficiently That is not the whole advantage however In the metal-clad airship, the surface cover or plating also holds the gas (thus eliminating the usual gas cells) and in combination with frame members, it actually takes a large share of the stress which the rubber fabric does not Hence the saving in weight

The general principle of construction of the metal-clad may be said to be similar to that of a steamship, in which the frame and plating are neither of them structurally self sufficient, but support and reinforce one another

An important development which arose in the experimental work, although not peculiar

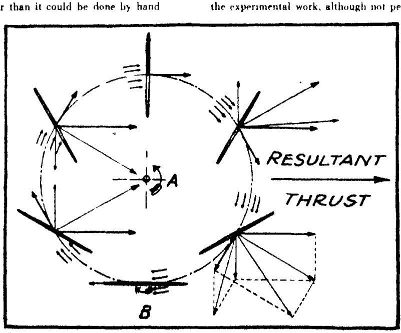

Figure 1: Diagram of action of the blades of the Kirsten-Boeing propeller. The resultant thrust for the disposition of the blades shown is horizontal and from left to right. By a simple mechanical movement the blades can have their relation to the circular path altered, so that the resultant thrust can be made to act in any direction

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to metal-clad construction, is worthy of note. It was found that a short stubby form, as shown in our illustration, with a ratio of length to diameter of only 3 4 to 1, was aerodynamically more efficient than the elongated shapes hitherto employed, and that the control and stability were also far better

Space does not permit us to describe many other interesting features of the design, nor is it possible to say definitely whether the idea will prove successful in practical operation. Nevertheless, it would seem that much has been achieved by these original and painstaking engineers

A Swivelling Propeller

IT has long been recognized that an airship would gain greatly in manoeuverability if the thrust could be made to vary in direction.

The Kirsten-Boeing propeller, invented by an American, but described fully for the first time in *Zeitschrift fur Flugtechnik*, seems to have achieved a versatility of thrust direction which is remarkable

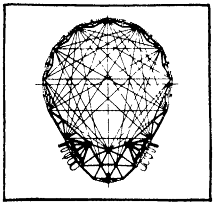

Figure 2· The Kirsten-Boeing propeller as applied to an airship of the Los Angeles type. Normally the propellers give a forward thrust, but they can be made to give up or down forces, a great advantage in airship control

The principle of the propeller is illustrated in the diagram of Figure 1 The six blades of the propeller rotate about its main axis in the direction shown by the curved arrow, A At the same time each blade rotates about an axis at its center in the direction shown by the curved arrow, B The rotation of B is half that of A, so that the blades turn only through 180 degrees while the whole propeller turns through 360 degrees In the particular disposition of the blades shown in Figure 1, the resultant thrust of all the blades is horizontal and from left to right If by a simple mechanical device the relative position of the blades is changed so that a blade is horizontal, for instance, when in the topmost position, then the resultant thrust becomes vertical.

Unfortunately, an exact description of all the mechanical features of the device is not available, but Figure 2 will give our readers a fair idea of the application of the Kirsten-Boeing propeller to an airship. Only the blades of the propeller project outside the airship; the driving mechanism and the mechanism for altering the position of the blades are all within the hull. Normally, the propellers on both sides exercise a forward thrust. But they can also be made to act up or down or even backwards. If two propellers are placed at the stern of the airship they can be made to act as rudders, or elevators.

The advantages of the propeller in the handling of the airship are obvious. Control is maintained even when the airship is at rest, whereas with the ordinary rudder a turning movement is obtainable only when the airship is under way Vertical control is also enormously increased For example, if an airship in the course of a long journey is becoming light owing to consumption of fuel, the propellers can be made to give a downward thrust, thus eliminating the necessity of valving gas or for the employment of ballast recovery methods.

The Kirsten Boeing propeller has been tried experimentally in the model basin and on a fast motorboat (it is applicable to either air or water vessels) with entire success, and its further progress will be worthy of interest.

Snow Skids

FITTING snow skids to an airplane is much more of an engineering problem than would be apparent at first

The skid must be free to rock about the axle (which travels upwards against the resistance of rubber shock absorbers) but must not rock too much, hence the provision of long rubber strands at the rear and front of the skid The skid must be as small and light as possible, yet provide sufficient area for the bearing pressure on the snow to be moderate, and have just the right curve to its surface in front to enable the plane to make a quick get away or a landing without plowing over

A typical and entirely satisfactory construction is shown in our illustration

A Modern Instrument Board

OUR illustration shows a typical, modern dashboard for a cross-country flight. Pioneer aviators used to rely almost entirely on their senses to gage both the equilibrium and the maneuvers of their planes Modern pilots use every instrument that science can provide In this particular dashboard, designed by Morris M Titterington, every requirement of scientific flying is provided for.

In the top row, left to right are: the oil-

(*Continued on page 356*)

Wide World

A well arranged dashboard in the modern airplane

SCIENTIFIC AMERICAN

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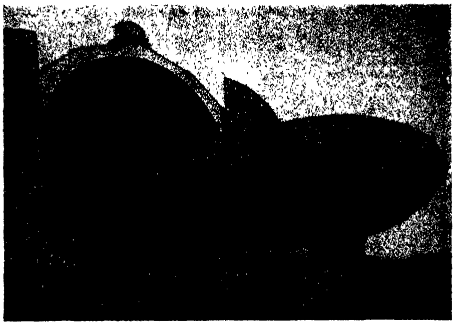


Wide World

The Army Air Service RS-1 being slowly hauled out of its hangar. It is one of the largest *semi-rigid* airships in the world

pressure gage, which indicates whether the motor is receiving the correct amount of lubrication, the air-speed indicator, which shows the speed of the plane relative to the air, and not only gives an indication of the distance flown (*not entirely correctly, since* it does not allow for the speed of the wind) but also warns the aviator in case his speed falls too low for normal flight; the bank-and-turn indicator, which tells the pilot whether he is flying on an even keel and in a straight line, and is particularly important in fog flying when there is no horizon or landmark to refer to; and last in the top row is the climb indicator, an extremely sensitive instrument which is most important in climbing tests of the airplane

In the bottom row, left to right are the radiator thermometer, which warns the pilot in case his motor is overheating, the tachometer, which tells him whether his motor is turning up the proper amount of revolutions; the fuel level gage, which warns him when his gas is running low; and the altimeter, which tells him the height of the plane The electric clock and the control switch complete the equipment

A Huge Semi-rigid

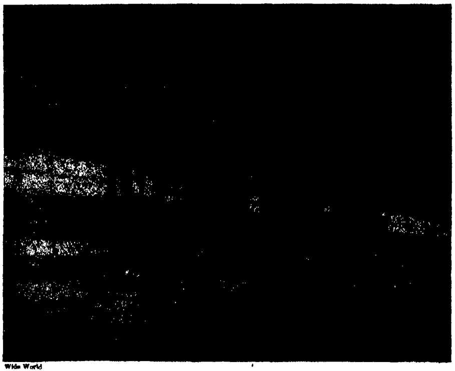
AIRSHIPS may be broadly divided into three classes: rigid, semi-rigid and non-rigid In the rigid airship, reliance is placed solely on the metal framework for the maintenance of the correct outer form, in the non-rigid, excess internal pressure of the gas puts tension in the fabric and counteracts any tendency to deformation due to the loads carried; in the semi-rigid, gas pressure is combined with a truss or keel running the whole under length of the airship.

From the point of view of useful load, the rigid is inferior to both the other types; in the non-rigid it is difficult to maintain form except for comparatively small airships. By many designers the semi-rigid is regarded as a happy compromise, not so heavy in its structure as the rigid of the *Los Angeles* type, yet withstanding deformations successfully in quite large designs

The United States Army *RS-1* is one of the largest semi-rigids ever built and it has proved entirely successful on its maiden flights The *RS 1* measures 282 feet in length and has a gas capacity of 760,000 cubic feet of helium—approximately one-third that of the *Los Angeles*. It recently carried 13 passengers with 4,200 pounds of gasoline at an average speed of 40 miles an hour; fully loaded with gas it can make a sustained flight of 2,000 miles.

In one of our illustrations we show the entire length of the airship as it is being slowly hauled out of the hangar, with its control cabin forward and the engine nacelle in the rear The other illustration shows how carefully the control cabin is streamlined into the envelope

The control cabin of the *RS-1* is quite as complicated and well-equipped as that of the larger *Los Angeles*.



Wide World

The well equipped control cabin of the RS-1 carefully streamlined into the hull of the airship

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

If a manufacturer licenses your invention on a royalty basis and it is a success, that usually is the best arrangement for you There have been cases, however, where a manufacturer has obtained from an inventor an exclusive contract for the manufacture and sale of the invented article, and has done so, not because he wanted to make it, but because he wanted to prevent anyone else from making or selling the article He has guaranteed to give the inventor a certain percentage of the profits or a certain fixed sum for each article sold. As none of them were sold, the inventor's royalty amounted to nothing The inventor had no redress. He was bound by contract.

To avoid this danger, *don't fail to see to it that any contract providing for a royalty has a minimum guarantee—that there is some provision which will insure that the article actually is to be made and sold—which will make it against the interest of the manufacturer not to sell it, or that the contract is cancelled if the minimum is not produced*

(More don'ts will appear in this department from time to time)

Radio Sets at Half Price

MANY merchants are like St Paul—all things to all men. Walk into a drug store and you can buy anything from a ham sandwich to a set of razor blades, in a cigar store you can purchase tooth powder or candy. Naturally, the department stores assail this state of affairs at every opportunity

Recently, Wanamaker's New York store printed an advertisement telling about a large quantity of Thermiodyne radio sets which were to be sold at half price After describing the Thermiodyne national advertising campaign and how the sets had been sold through the United Cigar Stores, it went on:

"Then came the awakening—the public wants to buy their radios from radio stores, who know their business, who know the product, who, because of their knowledge, can advise purchasers what to buy, show them how to use it, install it, and stand back of it with real service. The great idea did not succeed. It was based on a wrong method of distribution"

J W. Guilbord, president of the Thermiodine Radio Corporation, however, is quoted as follows:

"Like other radio manufacturers we planned for a big year in 1925 and, like other radio manufacturers, we ran into what the trade is already aware was a year of overproduction. We made a special deal for New York City alone with the United Cigar Stores. When this plan did not produce the expected sales and inquiries, the failure, such as it was, was confined entirely to New York, and was only an incident in our campaign as a whole."

In 1925 the Thermiodyne spent $500,000 on advertising. This year they will advertise almost as heavily. Wanamaker's, following the appearance of their advertisement in the newspapers, sold Thermiodynes at the rate of 500 a day.

National Biscuit Triumphs

IN the March issue an item appeared in this department, under the caption "Victory for Small Grocers," telling how the Federal Trade Commission had ordered the National Biscuit Company to discontinue making price discriminations in favor of chain grocery stores and against independent grocers organized into associations

The general counsel for the National Biscuit Company calls our attention to the fact that the Circuit Court of Appeals sitting in New York reversed and set aside the order of the Federal Trade Commission in this case saying We conclude that the sales policy of the petitioners as to their discount plan, as well as the refusal to sell cooperative or pooling buyers, is fair in all respects as to all its competitors and customers"

Not only that but the Supreme Court of the United States found no error in the decision of the Circuit Court of Appeals and refused to review the case

We accept the amendment Thank you, counsellor

Taking Stock of Industry

THAT the wheels of American industry are whirling at ever-increasing speed is generally appreciated The rate of this acceleration has now been measured and the figures are startling even to the most confirmed of optimists

The Bureau of the Census has recently published its Census of Manufacturers for 1923 To make a proper comparison with preceding census years we must go back to 1914, the years 1919 and 1921 being abnormal, the former being characterized by unusual industrial activity and the latter by industrial depression

In 1923 there were 196 309 industrial establishments valued at $5,000 or more In 1914 there were 272,518 On the face of it that hardly looks like growth But wait

In 1923 the number of men and women at work in these industries averaged 8,778,156. In 1914 the average was 7,023,685 A gain of approximately 25 percent

The wages paid in 1923 totaled $11,009,298,000 In 1914 they amounted to $4,067,718,000 This increase is startling, but the figures need some readjustment A dollar in 1923 had dropped 48 percent in purchasing power from the purchasing power of a dollar in 1914 Calling the payroll of 1923, then, only $5,724,835,000 we find the wage increase is 40 percent over 1914

Materials for the industries in 1923 cost $34 705 698,000, in 1914 they cost $14,358,935,000 Again we readjust the figures in the light of the dollar's decreased value and we fix the 1923 cost at $18 046,963,000 A gain of 25 percent

The value of the finished products turned out by these industries was $60,555,998,000 in 1923 the value in 1914 was $24,216,515,000 Thus the values added by manufacture were $25 850 300 000 in 1923 and $9,857,580,000 in 1914 *A gain of 38 percent in value created*

In 1923 the primary horsepower used was 33 094 228, in 1914 it was 22,401,401 An increase of 47 percent

Such figures are abundant food for thought There are fewer industrial plants but more men are employed Obviously, the plants are bigger The gain in numbers of workers was approximately 25 percent but their earnings increased 40 percent

Materials cost 25 percent more in 1923 but the increase in their value exceeded the added values of 1914 by 38 percent And this greater value increase resulted directly from the use of 47 percent more horsepower

Consolidation of smaller plants into bigger ones, greater reliance upon machinery less upon man power, and, as a result, greater wealth for the country and for its workers—such is the record of science in industry as set down in the figures of the Census Bureau

Development in many lines is at a standstill until some device renders it practicable. Navigation of our great ships is possible because Daniel E. Sickles invented the steam steering apparatus in 1858. This is the first one used

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion, minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

GARTER, ARMLET, OR LIKE BAND —Adapted to be worn on an article of wearing apparel, in encircling relation, to prevent accidental displacement of the article Patent 1569968 L M Davis, Fairmont, W Va.

HAT —Having adjustable means for permitting a variation in head sizes without changing the general appearance of a ladies' hat Patent 1571107 Agnes Capelle and H Harris, c/o Harris & Capelle, 64 W. 36th St, New York, N Y

WOODEN SHOE —For protecting the feet of bathers against cuts, in going to and from the water, and against injury from sea life Patent 1571498. C J Swanstrom, P. O Box 43, Coronado Beach, Calif.

ORNAMENTAL BUTTON.—Which will disclose a button structure with an ornament thereon, and may be readily stitched to a garment. Patent 1572803. A I. Lewis, 87 Gerard Place, Newark, N J.

Chemical Processes

PROCESS FOR MAKING WATERPROOF PORTLAND CEMENT —Which consists in thoroughly incorporating into a cementitious material a mixture of "beta naphthol" and non-volatile oil. Patent 1566498 C N Miller, 416 Funston Ave., San Francisco, Calif.

PROCESS FOR THE DISTILLATION OF NATURAL RESINS AND OLEORESINS —Which comprises mixing therewith from 1 to 5 percent of tribasic phosphoric acid, and distilling the mixture at a temperature of 310 degrees centigrade. Patent 1572766 J M A Chevalier, P. Bourcet, H. Regnault, c/o C Chassevent, 11 Boulevard De Magenta, Paris, France.

Electrical Devices

METHOD FOR STARTING AN ARC IN A WELDING APPARATUS.—By the superimposing of a high voltage high frequency current of small amperage on the circuit containing the low voltage source of energy for the purpose of causing the high voltage current to jump across the gap under conditions which would not allow the low voltage current to become active Patents 1570803 and 1570804 F L Walker, Jr, Box 1648, Stanford University, California

ILLUMINATED SIGN —In which is placed a series of electric lights to illuminate different letters or figures and make them visible Patent 1569423 G A Griffin, Oakland, Calif

THERMOELECTRIC ELEMENT —For thermocouplers, which produces a relatively high electro motive force when joined to a positive element Patent 1572117 O Hermann, c/o Thermo Electric Battery Co, 1142 Diversey Parkway, Chicago, Ill

TELEPHONE RECEIVER —In which the vibration of a diaphragm in response to current frequencies can be placed with a minimum amount of distortion Patent 1573754 D. Wald, c/o United Scientific Laboratories, 80 4th Ave, New York, N Y.

LAMP LOCK —For lamps of the incandescent type, which operates to prevent theft, the lamp being unmovable without destruction Patent 1573717 C Killars, 103 Main St, Stonington, Conn

HEATER FOR PERMANENT HAIR WAVING —By means of which the heat may be applied either to the root portion, or uniformly to the whole hair under treatment Patent 1573761 A H. Bongers, 7 The Exchange, Muswell Hill, London, N 10, England

Of Interest to Farmers

DRAFT EQUALIZER —Whereby the pull exerted by a plurality of draft animals on an implement will be transmitted in a single horizontal plane Patent 1563801 E R Spellman, Box 796, Walla Walla, Wash

SUGAR CANE HARVESTER —By which cane stalks may be severed in an efficient manner and then cut into proper lengths for the grinding machine. Patent 1570003 W Snodgrass, Central Senada, Camaguey, Cuba.

Spot Marker for Corn Planters.—By means of which corn may be planted without the necessity of using wires for guiding the planter. Patent 1570773 J P Oeschger and E. S. Jones, c/o J P. Oeschger, 1244 N La Salle St., Chicago, Ill.

Of General Interest

Recording System —For keeping a record of the steps in the manufacture of articles, that the cost of the finished article may be ascertained. Patent 1567981 C D. Page and F. A Behounek, c/o Page Printing Co., Grand Forks, N D.

Safety Magazine for Explosives and Ammunitions. — Constructed to warrant safety either against atmospheric electrical discharges or the action of bombs from airplanes or batteries Patent 1567893 F Baratta, c/o L Laboccetta, Via Due Marcelli 31, Rome, Italy

Apparatus for Sand Blast Carving — By which the carving of wood and like material is economically facilitated, without requiring the employment of skilled workmanship. Patent 1566711 I. B Wellington, 4044 Moneta Ave, Los Angeles, Calif

Liquid Wax for Threads —For thoroughly impregnating threads used in the manufacture of leather goods and for preserving the threads against ready breakage Patent 1567497 J Fry, Canton, Mississippi.

Bank Check —So constructed as to prevent the changing of the amount of money for which the check was originally made payable Patent 1567613 J. Patton, Jr., 206 Brown St, Charleston, W Va

Key-Chain Reel —A small and light weight device, attachable to a belt from which keys may be withdrawn and will return by spring pressure Patent 1567783 W Best, 2130 W North Ave, Chicago, Ill.

Ice Can Filler —By which cans used in ice manufactories may be filled with just the proper amount of water, without movement after filling Patent 1567161 V P Miller, c/o Miller Ice Co, Center Ave. and Main St, Chicago Heights, Ill

Toothbrush —In which the bristles are mounted upon a member which may be removed from the handle at will for replacement Patent 1567507 A. A Howard, 4057 Montgomery St, Chicago, Ill

Note-Book Clip —For securing a note book from unintentional dislodgment from the pocket of the user Patent 1567315 A Zaremba, 805 W. Washington Blvd, Chicago, Ill

Envelope —For registered mail, in which a return post-office receipt constitutes a detachable extension of the flap Patent 1568880. V. A Conklin, 513 5th Ave, Belmar, N J.

Eyeshades.—Which may be used alone or in connection with eye glasses to shield the eyes against certain rays of the sun Patent 1568900. H A Metcalf, 286 5th Ave, New York, N Y

Retainer Clip —For use in supporting a fountain pen or lead pencil in an upright condition in a pocket Patent 1568889 A S Eliasson, 150-37 21st St., Whitestone, N Y.

Gem Setting —In which the gem may never be accidentally detached from a ring as long as the ring is on the finger of the wearer Patent 1568924 A Shatkin, 1407 40th St, Brooklyn, N Y

Spout for Sugar Bowls —Which can be readily attached to most any kind of sugar container or readily detached for the purpose of cleaning Patent 1568923 I Ruiz, c/o William O Hahn, 2649 8th Ave, New York, N Y.

Combined Seat and Desk —In which both can be adjusted vertically and secured in position, or packed in a small space for storage or shipment Patent 1568211. S W Conwell, Grand River, Iowa

Burglar Alarm —In the form of a bell, adapted to be mounted on any window sash, to ring on the movement of either sash Patent 1568882 A E Coyne, 28 Waverly Place, New York, N Y.

Cleaning Compound —Comprising ground shelled peanuts combined with camphor, adapted for cleaning and polishing furniture, automobiles and other articles Patent 1568910 T S Noguchi, c/o M Tujimois, 536 Ft Washington Ave, Apt G, New York, N Y

Re-enforced-Concrete Wall Section — By means of which an entire section of a building, with air space between the walls, may be manufactured in one piece, durable enough to permit the manipulation of the entire section. The inventor has been granted two patents, 1568265 and 1568266. C Carrillon, c/o J. M Keamon, Temple University, Philadelphia, Pa.

Tooth-Paste Ejector.—Including a supporting bracket for holding a collapsible tube of paste, and means for squeezing out the required quantity of paste Patent 1568921. T. H. and H Roberts, Cranford, N J.

Siphon Tube Holder.—For a flexible siphon tube, which will prevent kinks and sharp bends and prolong the life of the tube. Patent 1568931 D E. Thomas, 2024 Saxon St, Tampa, Fla

Unit Tray.—So constructed that a series of the trays may be readily locked into a vertical column to form a cabinet. Patent 1568468. E H Pratt, 220 So. 2nd St., Corvallis, Oregon

Adjustable Tip for Canes and the Like —The tip being resilient, and a new portion being brought into use as the old tip gradually wears Patent 1568423 C Sifferlen, 403 N Ottawa St, Joliet, Ill.

Work Cabinet.—Which in closed position has the appearance of an article of furniture, but when open supplies the necessary equipments for a hair dresser. Patent 1568498. A. Caliver, Fisk University, Nashville, Tenn.

Loose Leaf Binder.—In which the covers are secured to the back by a double hinge thereby assuming a flat position when opened Patent 1568403 H J Holst, Apt. 24, 1377 Bannock St, Denver, Col.

Casement Window —Of metal construction, wherein three or more contacts are presented, making a substantially airtight and watertight structure Patent 1568865. S U Barr, c/o W H Jackson & Co, 335 Carroll St, Brooklyn, N Y

Animal Trap —In which spring actuated means are employed to tighten a snare around the animal, the trap may be set in a small space Patent 1567214 L R Van Tassel, Bear Creek Camp, Sheffield, Pa

Laundry Case —For boxes or fillers, which co act with the case to present a complete grip or suit case structure Patent 1569784 H E Plimpton, c/o Plimpton Mfg. Co, Norwood, Mass.

Picture and Object Target —Adapted for use in the practice of archery, wherein the figures presented at different places on the target act as bull's eyes Patent 1569,-781 R P. Orr, 45 Parkwood Ave, Schenectady, N Y

Vanity Case —And mirror assemblage, in which the mirror shows through the bottom, and is available without opening the case Patent 1569779 C Nachemov, c/o A J. Sossner, 361 W Broadway, New York, N Y.

Trousers Creaser —Adapted to be inserted in the leg of the trousers and to exert tension thereon to form the creases Patent 1569792 A T Smith, 4589 Lexington Ave., Los Angeles, Calif

Pencil Attachment —Acting as a clip for retaining the pencil in a pocket, and greatly facilitate the work in checking and paging a ledger Patent 1569742 J B. Goerling Wausau, Wis

Fishway — Adapted to be associated with a dam, for the passage of fish from the water below to the water above the dam Patent 1569419. N D Chase, Hornbrook, Calif

Card Shuffler —Adapted to receive a deck of cards and thoroughly mix them when the device is shaken Patent 1569277. C A and W J Gunzelman, R F. D. No 3, Abilene, Kans

Making Moving Pictures —And producing composite cinematographic pictures, by the use of a plurality of mirrors so that several personages at different points may be combined into a picture Patent 1569789. E Schufftan, 1938 Argyle Ave, Hollywood, Calif

Roof or Building Tile —In the form of a molded plastic material, such for example as abestos-cement, covered with a thin sheet of non ferrous metal Patent 1570504 L. Lane, Box 1066, Habana, Cuba

Air Boat —In the nature of a raft having a bottom, and double pneumatic chambers, and means for uniformly distributing a load Patent 1570470 W P Fritsche and J D Clarke, c/o Clarke & Fritsche, New England Airship Co, New Haven, Conn

Article of Furniture.—Which may be transported in knockdown condition and readily assembled to form an umbrella stand. Patent 1570532 A L. Strouse and S. Weinschenk, c/o S. Weinschenk, 9520 107th St., Richmond Hill, N. Y.

Hand Bag.—So formed that it may be readily converted from a leather bag to a cloth bag or the reverse. Patent 1570515. E. Meltzer, 64 Grand St., New York, N. Y.

Manufacture of Margarine and Edible Fats.—Comprising a mixture of vegetable fats and an emulsifying oil—soluble gelatinised oil. Patent 1570529. E. V. Schou, Palsgaard near Juelsminde, Denmark.

Roof Covering.—Comprising a plurality of roofing units arranged in courses with adjacent shingles, and locked to the roof sheeting and held against curling. Patent 1570152. J. E. Hooker, c/o H. & W. Realty Co., Ludlow and Southworth Bldg., Coral Gables, Fla.

Closure for Pipes, Valves and Other Vessels.—The threads employed being insulated by a double metallic seal from gases, fluids or vapors, within the pipe or article sealed. Patent 1569875. H. C Nixon, 749 Ave. H, So. Saskatoon, Saskatchewan, Can.

Umbrella Rack and Smoking Stand.—Having hinged members by means of which the device may be adjusted to act as a table, smoking stand, or umbrella rack. Patent 1570540. S Weinschenk, 9520 107th St., Richmond Hill, N. Y.

Process of Glazing Brick.—By applying glazing material, and fusing the same by passing an electric current through the brick and glazing material. Patent 1570137. A Fischer, Jr, 4502 N. Sacramento Ave., Chicago, Ill.

Shackle-Bolt Oiling Device.—In which the lubrication may be instantly effected and means provided for storing up the oil Patent 1570367 C F Wolf, 2528 N Drake Ave, Chicago, Ill

Process of Producing Artificial Snow —By passing an air blast through a previously prepared mass of hardened foam, produced with powdered casein, rennet and soluble calcium salt Patent 1569396 J A Rice, 805 Santa Barbara Rd, Berkeley, Calif

Folding Furniture —In which the supporting means is capable of collapsing to a minimum whereby the furniture may be compactly stored. Patent 1570863 F Simmons, 274 52nd St., Brooklyn, N. Y

Hardware and Tools

Tool for Removing from or Applying Differential Gears to Their Axles — The device is capable of adjustment to operate in vertical or horizontal position, and facilitates the application of the gears Patent 1567892. W. C. Bakels, Midland Park, N. J.

Garden Implement.—Adapted to be used as a cultivator, and having means for carrying a plurality of blades for engaging the ground Patent 1568136. W. A. Crump, Humble, Texas.

Wrench —Which affords facilities for turning nuts or like parts of a plurality of different sizes within a considerable range Patent 1569117 E R. Carpenter, Ansonville, N C.

Stopcock —Having novel packing means for preventing escape of fluid, and means for keeping the moving parts well lubricated Patent 1569252. J. A. Barnes, Box 631, Burkburnett, Texas

Lawn-Dressing Implement.—For effecting a uniform distribution of top dressing upon the grass, and working the dressing downwardly toward the roots. Patent 1569,-421. M. T. Coelho, Box 89, Redwood City, Calif.

Automatic Latch.—Disposed within the casing, but having a projecting handle whereby the latch may be operated from either side of the door. Patent 1570135. G C Emmert, Box 285, Mount Morris, Ill.

Pipe Connection.—Which may be used with pipes having roughly or smoothly cut ends, so as to positively prevent leakage Patent 1570155 V. Karbowski, 1227 Milwaukee Ave, Chicago, Ill

Grinding Tool —Adapted for cleaning electrical contacts carried by the shell of a timer, of the character employed in connection with ignition systems. Patent 1570166. A Morris, Sabina, Ohio.

Method of Manufacturing Horseshoe Calks.—From a high carbon steel wire section by a cold process during which the wire is subjected to impact and pressure. Patent 1570455. T. F. Boylan, Sr., c/o Eversharp Mfg. Co., 330 Townsend St., New Brunswick, N. J.

Pipe Wrench.—Simple and durable in construction, reliable and effective in operation, and adapted for economical manufacture. Patent 1570627. E. J. Evans and W. H Barber, 147 Regent St., Salt Lake City, Utah.

Drill Bit.—Having its cutting edge so disposed near the periphery of the bit, that it will be most effective for cutting hard rock. Patent 1571848. C. O. Stee, Quartzburg, Ida.

Extension Bit —Having fastening means adjustable to bits of different sizes, the bits being quickly secured and firmly held. Patent 1571497. G. W. Staley, 3960A 18th St., San Francisco, Calif.

Padlock.—In which means is provided for positively precluding movement of the shackle without first removing the key actuated locking core. Patent 1572122. J. Pietrie, 2219 Iowa St., Chicago, Ill.

Safety Razor —In which the cutting edge may be disposed at the desired angle, and the blade removed in a single operation. Patent 1572572. J Straka, c/o W. R. Piper, 417 1st Nat'l Bank Bldg., Oakland, Cal.

Gutter Hanger.—Adapted to have portions not only for embracing the gutter bottom exterior, but also for straddling the top. Patent 1572745. C Meunier, Great Neck, N Y

Self-Locking Door Bolt.—For swing doors, adapted to be automatically released and moved to locking position by the closing of the door. Patent 1573653 J H. Stewart, 714 Clifton Ave., Newark, N J.

Heating and Lighting

Hot Air Regulating Device.—Adapted for use in pipes leading from hot air furnaces, for controlling the hot air flow and conserving the heat. Patent 1570290. A. Unger, 7744 S May St., Chicago, Ill.

Time Controlled Regulator for Heating Systems —By means of which additional weights may be engaged with a standard type weigh actuated temperature regulator, and varied at will Patent 1570,-082. H W Royce, 7543 Chapple Ave., Chicago, Ill.

Heater —Provided with a special form of baffle or draft regulator associated with the flue Patent 1571079. E. Witman, Sinking Spring, Pa

Device for Illuminating Oil Gages — Having means for preventing the unintentional removal of a combined guard and reflecting element from the gage Patent 1570179 M. D Prouty, R. Craig, C Rawlings and H Carlson, c/o Electric Light Oil Gage Co, Galva, Iowa

Gas Burner —For cooking stoves, for use in a top opening or oven bottom, with the result that practically all the heat may be used Patent 1571822 E E. Wann, 1717 7th St N W., Washington, D C.

Machines and Mechanical Devices

Automatic Sheave.—Especially designed for organization with rotary drilling outfits for use in cat heading drill pipe in and out of wells Patent 1568406 J. E. Le Bus, c/o J. E. Le Bus & Son, Electra, Texas.

Gravity Register —The primary moving element being a ball, adapted to be released and then perform certain registering operations. Patent 1568272. F. G. Diago, Box 1972, Habana, Cuba.

Apparatus for Spudding, Drilling and Cleaning Out Water and Oil Wells.—The device being readily portable and capable of being carried by an automobile truck or similar vehicle. Patent 1568430. C. Uhl, 301 Chickasaw Ave., Bartlesville, Okla.

Filling Machine.—Operated by pressure applied to the fluid or semi-fluid material to be filled, and will deliver a predetermined quantity Patent 1569300. J. Purvis, Jr., 6405 So. Spaulding Ave., Chicago, Ill.

Traveling Bridge Crane.—Which will quickly and safely pick up and set down a railroad car, or any other standard shaped object. Patent 1569269. F. W. Eagelston, 1416 Dodge St., Room 205, Omaha, Neb.

Platen Return —Or relift, for use on machines of the type embodying a rotary printing drum and a roller platen, such as the multigraph. Patent 1569284. W. Kastler, 2808 Bartold Ave., Maplewood, Mo.

Machine for Grinding Grain.—Which will grind or crush the grain for feed purposes, and discharge the ground grain to any desirable place. Patent 1569561. G. E. Miller, Stratton, Neb.

Combined Finishing Machine for Pile Fabrics.—Which may be readily adjusted to produce a pile raising operation to any desired extent during the process of finishing Patent 1569785. M. Poetzsch, 91 Overbrook Road, Ridgewood, N. J.

Valve.—Adapted to be attached to any cylinder steering gear, such as are used on stern wheel steamboats, for holding the rudder in position. Patent 1569417. G T. Bollinger, c/o Barker Barge Line, Lockport, La.

Film Printing Machine.—Which may be adjusted to accommodate any desired width or length of film strip, or may be used for printing from plates. Patent 1570498. J. Kalmanovitch, 4419 13th Ave., Brooklyn, N. Y.

Road Grader.—So constructed as to entirely eliminate play between the cutting edge and the grader frame or circle. Patent 1570140. C. E. Gilbert, c/o The Gilbert Mfg. Co, Aberdeen, S. D.

Floor Cleaning and Polishing Device.—In the form of a roller, adapted to be rotatably supported for movement in contact with the floor surface. Patent 1570127 E. J. Barch, 185 Adams St., Memphis, Tenn.

Shuttle Attachment.—Which tensions the thread as it is fed from the bobbin, controls movement, and severs the thread, if imperfect. Patent 1571114. T. J. Garisio, 637 N 5th Ave., Allentown, Pa.

Hoist Control Unit—Which is intended for use with hydraulic brake actuating mechanism, having means for operating the valves of the hydraulic system. Patent 1570753 H. H Logan, c/o Duro-Metal Products Co, 2649-59 N. Kildare Ave, Chicago, Ill

Textile-Finishing Machine.—For facilitating the operation of smoothing the fabric and imparting thereto a high luster or natural sheen Patent 1571802. F. W P. Rose and C Werner, c/o Werner & Co., 183 Autumn Ave., Passaic, N J.

Compensating Device for Pumps—Which may be readily connected to any size pump and to efficiently function to substantially maintain the discharge. Patent 1571,781 R. H Aldrich, R F. D. No 2, Summit Lawn, Allentown, Pa

Machine for Forming Tubular Fabrics—For stitching together the edges of a strip of material, and pressing down and securing the same, in connection with a sewing machine. Patent 1571774 P. Gardner, c/o H M Bunker Co, 56 North St., New York, N. Y.

Light Control Attachment for Film Printing Machines—For printing motion picture films, in which the intensity of the light may remain constant or be varied by a light aperture. Patent 1572798. R. C. Hubbard and A E Mutscher, c/o Consolidated Films Corp., 729 7th Ave., New York, N. Y.

Automobile Hoist.—Adapted for raising an automobile that a workman can work thereunder and avoid the necessity of a pit. Patent 1571178. J. P. Donovan, 137 8th Ave., San Francisco, Calif.

Wrist-Pin Connection.—Which obviates the necessity of set screws, but will prevent longitudinal movement of the wrist pin with respect to the piston. Patent 1572795 D. Head, 1320 Birchwood Ave., Chicago, Ill.

Combined Sand Pump and Drill—By means of which no time is lost between the agitating of the sand at the well bottom, and the pumping. Patent 1572274. S. R Evans and S. W. Collins, 314 W. Fairview, Tulsa, Okla.

Automatic Flow Controller.—Which may function as a trap to discharge condensation from steam boilers, or as an overflow device for various purposes. Patent 1572784. D. A. Fleming, Pennsylvania State Normal School, Indiana, Pa.

Centrifugal Separator.—For separating solid matter suspended in a liquid in cases where the specific gravity between the elements is comparatively small. Patent 1572,299. F. W. McEntire, Hotel Utah, Salt Lake City, Utah.

Medical and Surgical Devices

Neurovertameter.—For the purpose of analysis and subsequent relocation of subluxated vertebrae in the human spine, as one of the operations in chiropractic. Patent 1571140. M. F. O'Connor, Sheridan, Wyoming.

Hypodermic Syringe.—Having a removable needle, which may be sterilized in a high temperature flame without injury to the needle Patent 1569961. M. F Bauchert, 803 1st Nat'l Bank Bldg., El Paso, Texas.

Massage Apparatus.—By means of which the patient may personally operate the same, for treating the spine to adjust or correct defects. Patent 1572794. C L. Hamilton, 7907 5th Ave., N. E. Seattle, Wash.

Optical Device.—For training the eyes in unconscious shifting, and for proving to a patient the benefit from the practice of shifting. Patent 1572760. R. R. Arnau, c/o G. Ruiz, 16 Almarzo St., Madrid, Spain.

Trocar.—An instrument characterized by the special form of cut it makes, used for the exclusive purpose of operating on food-bound animals. Patent 1573681. J G. Direaux, Maipu 671, Buenos Aires, Argentina.

Musical Devices

Music Instructor for Children.—By means of which the relation of the position of notes and the keys of the piano are easily made Patent 1558257 H. Fisher and D. Hoobler, c/o H H Fisher, Y M. C. A, 1400 E 53d St., Chicago, Ill.

Musical Instrument.—Having novel means for readily changing the mechanism which actuates the key hammers, whereby any tune may be played. Patent 1565439. H Haas, 519 E. Washington St., Marengo, Ill.

Pedal Protector.—Which may be conveniently applied to the pedals of player pianos to preserve the same. Patent 1566,315. W. C. Daumueller, Lebanon, Ill

Prime Movers and Their Accessories

Muffler—Adapted to cause a cold stream of air to flow around exhaust gases, whereby the gases will be expelled in a steady stream Patent 1572116. F J. Herdle, 1847 W Huron St, Chicago, Ill.

Carburetor—In which a conical-shaped air controlled member is provided which gradually opens as the suction of the engine increases Patent 1573689 P A Dumraese, 5 New Haven Ave, Milford, Conn.

Air Filter—For filtering the air taken into the intake pipe of internal combustion motor carbureters to insure a cleaner mixture of combustible charge. Patent 1573656 R E Terhune, 861 E 27th St, Paterson, N. J

Railways and Their Accessories

Superheater Construction for Locomotives—Comprising a front superheater extending into the smoke box, and a rear superheater extending into the combustion chamber, connected by tubes. Patent 1563,683 F. A Benolken, c/o Rev J. H O'Neill, Mount St Charles College, Helena, Mont.

Feed Water Heater for Locomotives—Having a tubular casing of annular form, the ends of the casing communicating with the steam chamber of a coupling. Patent 1567514. J H. Kidwell, 422 Harle St., Staunton, Va

Sleeping-Car Ladder.—For rendering the upper berth of a railway sleeping car conveniently accessible, and to prevent accidental falling of an occupant. Patent 1568,846 H. I Jones and F. M. Pinkerton, 1538 Forest Ave., Wilmette, Ill.

Street Railway Construction.—In the form of paving blocks so designed as to be protected and reinforced at the points of greatest wear Patent 1568677. W F McCanless, Kinney Bldg., Charlotte, N. C.

Track Sander—Having a special nozzle with a blast channel opening into the sand outlet for dislodging clogged or frozen sand at this point. Patent 1569830. J. H Watters, Box 466, Anniston, Ala

Railroad-Crossing Gate.—On both sides of the tracks, the right-hand gate on each side being first closed to intercept traffic, the other gate closures following Patent 1569,908 E E. Beecher, c/o A. W Beecher, 1039 Ocean Ave, Brooklyn, N. Y.

Car Door—Which is sliding and laterally movable, and includes means for making a storm proof contact when closed Patent 1569834. B Fuller, R. F. D. Box 24A, Newark, Calif.

Journal Box Bearing.—Of the roller type, which can be readily applied to a standard railway car journal box without altering the journal or box Patent 1572121. H. Parker, c/o J. C. Parker, 1230 N. Dearborn St., Chicago, Ill.

Pertaining to Recreation

Amusement Device—In which cars are provided for seating passengers, to be operated to move over a convoluted annular platform. Patent 1564639. A. A. Stavick, Box 77, Sioux City, Iowa.

Skate.—Comprising a foot plate, to be firmly secured to the foot, supported on two hooded wheels one in advance of the other Patent 1566706. C. A. Thomas, Yakima, Wash.

Game.—Which in its character is somewhat similar to baseball played in a restricted area. Patent 1568013. H. C. Warfield, P. O. Box 183, Merrick, L. I, N. Y.

Golf Club Head—More particularly golfing irons, the striking faces of which are characterized by straight grooves for materially enhancing the users playing ability. Patent 1569212 J A G. Aitken, Longwood Ave., Holyoke, Mass

Child's Riding Toy.—Which in general appearance, and in its movements on a supporting surface closely resembles a miniature airplane. Patent 1569400 F. J. Schubert, 700 Demonbruen St, Nashville, Tenn

Figure Toy—In the form of a doll, operated by electro-magnetic means, which will cause the doll to operate a drum. Patent 1564674 H. C. Hodgkins, 7 Vley Road, Scotia, N. Y.

Amusement Device—Which will test the skill of the operator in manipulating a coin in its movements to answer questions in the nature of fortune telling Patent 1564841 C Fleischer, 52 Van Sinderson Ave., Brooklyn, N. Y.

Toy Amusement Device—Comprising a toy airplane which is adapted to be projected and to travel in the air at high velocity, a relatively great distance, with direction varied at will The inventor has been granted two patents, 1565437 and 1565438 J. Greife, 201 York St, Newport, Ky

Golf Bag—Known as caddy bags, in which the golfing sticks cannot be thrown against one another, being held separate, yet easily removable Patent 1570500 B Kennedy, c/o Ken-Wel Sporting Goods Co, Gloversville, N Y.

Toy Vehicle—Adapted to be straddled by a child and to be propelled by body movement of the rider Patent 1570849. R. H Manley, Cottonwood, Arizona

Doll—Which when caused to simulate a dance will issue sounds as if the doll were whistling Patent 1571868 G H Parsons, c/o Averill Mfg Co, Wales Ave and 143rd St, New York, N. Y.

Exerciser.—Permitting a person not having access to a gymnasium to have the benefits of a rowing machine at home Patent 1572802 C D Layman, 641 S 34th St., Louisville, Ky

Game—Including a target member, and members in the nature of catapults for effecting the movement of projectiles toward the target. Patent 1573711 L C Houle, Box 72, West Pittsburg, Pa

Pertaining to Vehicles

Stop and Direction Indicator—Which constitutes an illuminated device that may be strapped to the arm of the driver for night signaling Patent 1568361 E L Blanchfield, 981 Oliver St, San Pedro, Calif

Passenger Compartment.—For public conveyances, by means of which all possible space, ordinarily wasted, may be utilized by the use of tiers of seats Patent 1568855 A W Lawson, 1819 Broadway, New York, N. Y

Dirigible Headlight for Vehicles—In which the working mechanism is entirely housed and protected from dust or foreign matter Patent 1569261. J. M Calkins Box 611, Detroit, Mich

Implement Attachment for Tractors—Which permits the placing of the implement in front of the tractor, without altering the construction of the tractor Patent 1569011 C. E Gilbert, c/o Gilbert Mfg Co, Aberdeen, S D

Pressure Indicator—Permanently carried by the wheel, so that at a glance the exact air pressure may be ascertained, without soiling the hands Patent 1565123 G Dailey, Bison, So. Dak

Headlight.—Which is adjustable and controllable, and will properly illuminate the road without subjecting drivers of oncoming vehicles to blinding glares. Patent 1569282 E E. Hughes, c/o J. S. Egbert, Box 79, Wallace, Idaho

Operating Mechanism for Dirigible Headlights—Which imparts in a smooth and easy manner the proper movement to the headlights when the vehicle is steered Patent 1566074 G Cook, Box 53, Gillett, Wis.

Signaling Device—Comprising an arm extending in horizontal direction to indicate the stopping or turning of a vehicle, visible by day or night. Patent 1563790 J M. Reid, 501 Grant St, Pullman, Wash

Tractor—For garden or farm implements, adjustable for securing high speed with comparatively small power, or slow speed with comparatively great power Patent 1566230 G H Scanlan, c/o J A Sheehan, 44 Court St, Brooklyn, N Y

Dirigible Headlight for Vehicle—Adapted to turn automatically when the steering wheel is turned, and to throw the light just in front of the car Patent 1567,112 J M Calkins, Box 611, Detroit, Mich.

Tractor Hitch—Which will permit relative separation of the drawing and drawn vehicles under conditions such as when a mud hole is encountered Patent 1566740 C T Forrest, Le Grand, Calif

Motor Vehicle—Having means for steering and driving a plurality of vehicle axles directly, so that each axle is steered by the preceding one Patent 1566726 D H Bradley Apartado 56, Parral Chih, Mexico.

Brake Mechanism for Automobiles—Which provides operating means between the ordinary foot brake pedal and the emergency lever and the four wheels of the car Patent 1567982 I F Pfeiler, 429 Central Trust Bldg, Altoona, Pa

Axle Brace and Positioner.—Designed to engage the front axle and radius rods of a "Ford" car, and hold the axle in proper position Patent 1569095 J A Mebane, South Boston, Va.

Headlight In which the lighting unit is adjustable within the casing, so that the proper focusing of the light will eliminate glare Patent 1570491 W A Irwin and E S Schwartz, c/o E S Schwartz, 507 5th Ave, New York, N Y

Antiskid Attachment for Automobile Wheels—Which prevents the wheel from skidding, also provides an increase in the contacting portions of the wheel Patent 1570359 H B Lindhorst, Route No 3, Box 188, Springfield, Missouri

Direction Signal—Adapted to be manually moved to any one of several positions, to indicate the intentions of a motor vehicle driver Patent 1570158 N W Knight, E 1819 Ninth Ave, Spokane, Wash

Lens—Adapted for use in connection with headlights of motor vehicles for diffusing the light and eliminating glare Patent 1569073 F K Goettert, 123 Ellisworth Ave, San Mateo, Calif

Lining for Transmission and Brake Bands—Constructed from woven or textile fabric, for preventing the glazing of the face, and lengthening the life of the lining Patent 1571085 C Brahs, McBride Ave, Paterson, N. J

Attachment for Supply Tanks of Automobiles—Which will indicate to a driver the necessity of refilling the tank Patent 1571111 J W Farrior, Warsaw, N C

Speed Changing Transmission—By means of which it is possible to obtain either low or high speed of a driven shaft, in a gradual manner Patent 1570867 F H Tanner 37 Downend Road Bristol, England.

Towrope—Which may be conveniently applied to a car and quickly shortened or lengthened as required Patent 1572771 C. A Connelly Shelby, Ohio

Designs

Design for a Dress-Trimming Ornament—Patent 69289 Maude Siegel, c/o Franklin Simon & Co, 38th St and 5th Ave, New York, N Y

Design for a Doll—Patent 69252. J Chapman, 159 W 85th St, New York, N Y

Design for a Woven Fabric—Patent 69250 L Bluhm, c/o Phoenix Mfg Co, 40 Thomas St, New York, N Y

Design for a Ferris Wheel Toy—Patent 69335 E H Tunley, c/o Pickwick Mfg Co, 129 Patchen Ave, Brooklyn, N Y.

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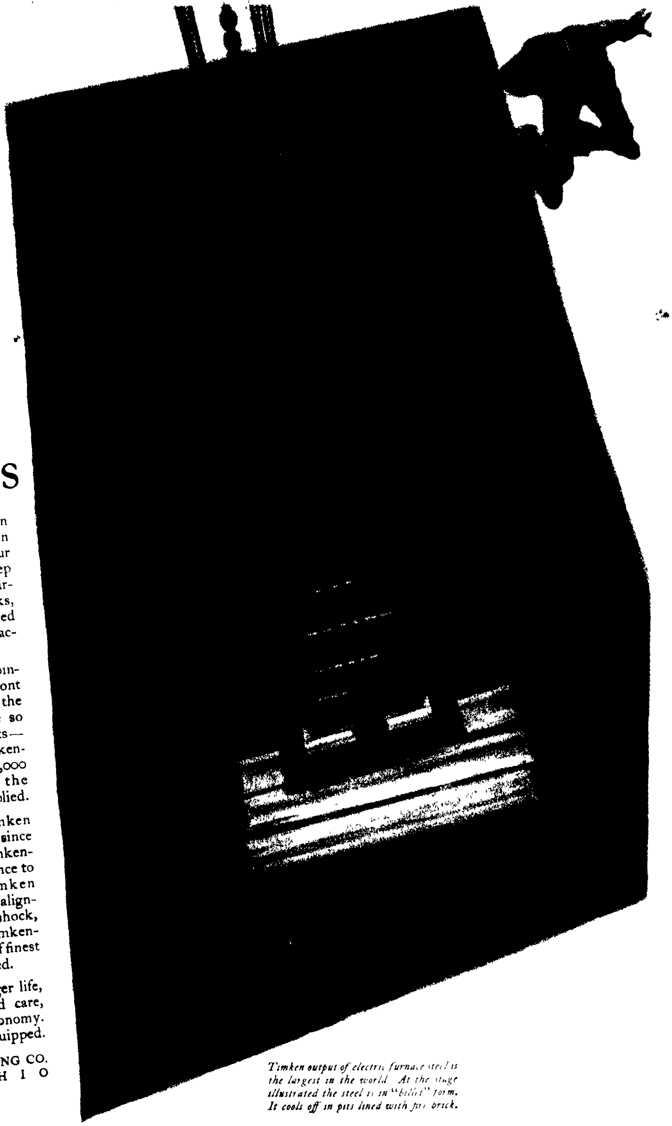

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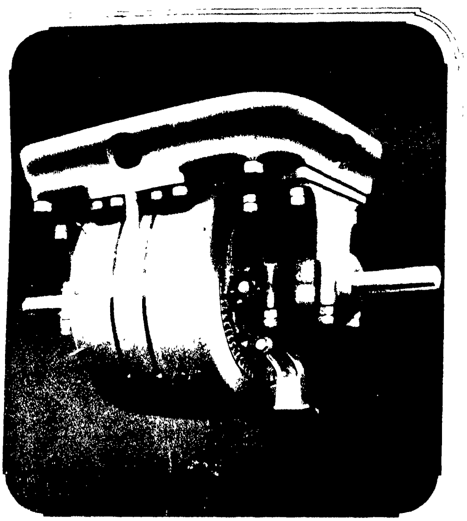

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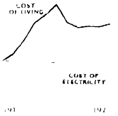

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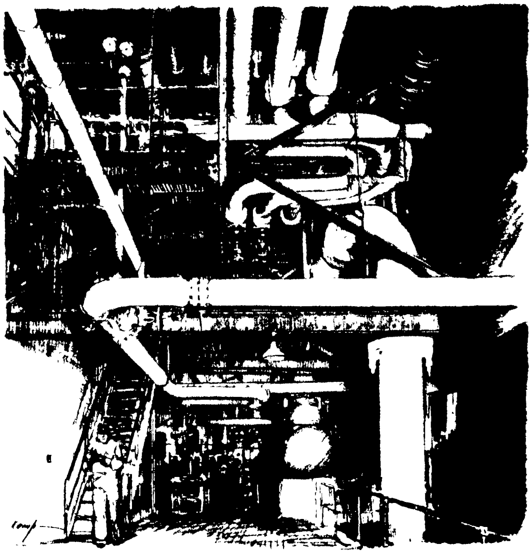

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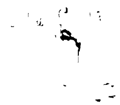

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A view in the header room, Crawford Avenue Station of Commonwealth Edison Company Chicago Two 50,000 kw and one 60,000 kw turbo-generators are served by 15 boilers already installed A 77,000 kw turbo-generator and 5 more boilers now being added Pressure 600 pounds, temperature 750° Sargent and Lundy Chicago engineers Graham Anderson Probst and White architects Piping installed by W A Pope, Chicago

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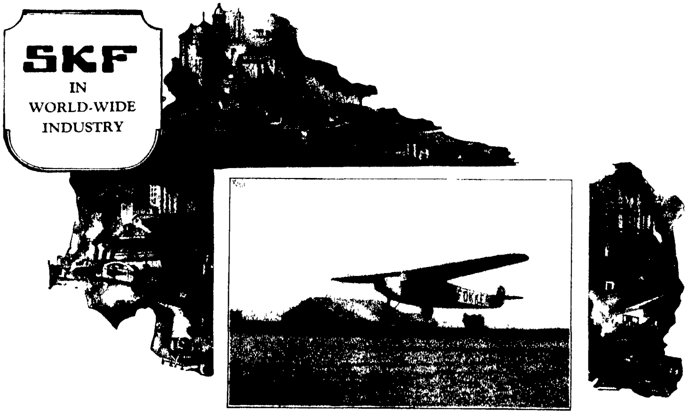

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SCIENTIFIC AMERICAN
THE MAGAZINE OF TODAY AND TOMORROW
NEW YORK, JUNE, 1926 EIGHTY-SECOND YEAR

ARCTICS

WHY should seven expeditions be headed for the North Pole?

The answer is that finding the Pole is not the main objective of these explorers, they wish to explore unknown lands of vast extent believed to lie about the Pole. A short air route from America to Asia may be charted These lands may hold mineral resources of vast wealth, the country claiming sovereignty over them by right of exploration and discovery may through them enhance its wealth many times in future years. It is to the interests of science and civilization generally that they be put on the map.

WASTE

THE waste of public funds by the politicians is proverbial. One of the latest instances of this is the voting of $250,000 by the Committee of the House for a new survey of the so-called "all-American" waterway from the Great Lakes to the sea Such a survey was made years ago by the Army Corps of Engineers and they reported against the advisability of the project. In spite of the alluring "all-American" title, the army engineers who are accustomed to dealing with cold hard facts, are certain to report once more that although such a canal can be dug, its cost will be so great as to be prohibitive The estimated cost is about 500 million dollars If the canal should be built by the Government, the politicians will get their finger in the pie—trust them for that—and when they do, the cost may mount to heaven-knows-what figure These gentlemen tell us that the ship canal will pass through a rich revenue-producing section of the country, and that the factories on its banks will be heavy shippers As a matter of fact, they will neither load nor unload a ton of freight from big lake steamers of 5,000 to 10,000 tons, for such ships will never tie up at a local dock to break out a small shipment from their holds.

CERTIFIED

A LAW has been passed in Turkey under which all persons who wish to marry must submit to a medical examination, according to the European Division of the Department of Commerce. In order to prevent substitution of a sick person for one who is well, the examining physician must stamp the left forearm of the marriage candidate This serves as a distinguishing mark to guide the authorities in granting the marriage license.

A capital idea! We have certified milk, certified eggs and certified bonds. Why not certified wives and husbands?

In This Issue

How Burbank "Created" Plants
What many people thought was Burbank's natural "gift" for creating new and better plants was largely a clear headed understanding of Nature's age-old methods of doing the same thing In a remarkably revealing posthumous article the late Mr Burbank tells others how to carry on his work Page 365.

How Hot Is the Earth's Interior?
New knowledge, new methods, have taught science new facts concerning the hidden center of the earth it is not so hot as we thought it was On page 370, Dr F W. Clarke, noted government scientist, discusses this interesting question

"Hey, Fellers, the Sap's Runnin'!"
Do you remember the days when you tapped your maple trees, and if you could, the neighbors' also? How the spring sap oozed out! What was it that made that sap rise? Science has solved the interesting problem and there are some surprises in it Page 378.

Make Your Boy a Scientist
Perhaps he will never grow rich—few scientists do—but you will be proud of him There is no saner, healthier way to turn a boy's mind towards serious things than to make a scout of him Put this magazine where the boy will "accidentally" find it—thereby you may plant a seed Page 382

Radio Chatter from the Arctic
The aviator explorers in the Far North will try to reach you by radio If you own a short wave set you may pick up all kinds of good stuff straight from the Far North Page 389.

MORE THAN 200 PICTURES

Complete table of content will be found on page 430.

For Next Month

Where Did the Indian Come From
All sorts of theories have been advanced to explain the origin of the American Indian—most of them complicated, improbable, contrary to known facts The Indian's origin is comparatively simple Dr Ales Hrdlicka, famous Smithsonian Institution anthropologist, will tell about it

Do You Plant Your Crops "in the Moon?"
Intelligent folks have always pooh-poohed the old fashioned superstition of planting by the moon's phases Now it begins to look as if there might be something in it Professor Sheldon will tell you how to make some experiments with plants that may throw more light on the problem

"The Most Amazing Psychic Case in History"
So Dr Walter Franklin Prince, distinguished psychic research worker, characterizes Patience Worth. He describes the manner in which a St Louis woman receives dictation of high literary merit from some mysterious source.

Other articles on Natural History for Tourists, New Methods on the Farm, The Atmosphere in Cross Section, Social Intelligence Tests, Welland Ship Canal, A Precision Balancing Machine, Measuring the Color of Hay, Radio

MORE THAN 200 PICTURES

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LODGE

CABLE despatches from across the water have indicated that the Royal Society of Great Britain has been asked by one or more of its members to consider the advisability of requesting Sir Oliver Lodge to resign from the Society on the ground that his views on spiritualism or spiritism, to be more correct are prejudicial to the interests of the Society This attitude represents, surely, only a small minority among the members of the Society for it is incredible that this great institution should assume the right of censorship upon all expression of personal views by its members on general scientific subjects On the other hand, since Sir Oliver, because of his wonderful facility in writing down to the understanding of the general public has such a widely extended vogue, we think that he should be careful to make it known that when he writes as a so called spiritualist, he is giving merely his personal views, and that these views are not to be taken as an expression of the attitude and belief of the great Society to which he belongs

SIMPLE?

AN editorial office would not be an editorial office if it were not for the chap on the staff who is always bringing up peculiar questions and starting arguments Here is one of our latest questions What is the greatest number that can be indicated by means of three digits? Having found an answer that satisfies us we wonder whether some of our readers would not like to try this little problem There is no "catch" in it, no trick the regular methods of notation employed by mathematicians may be used

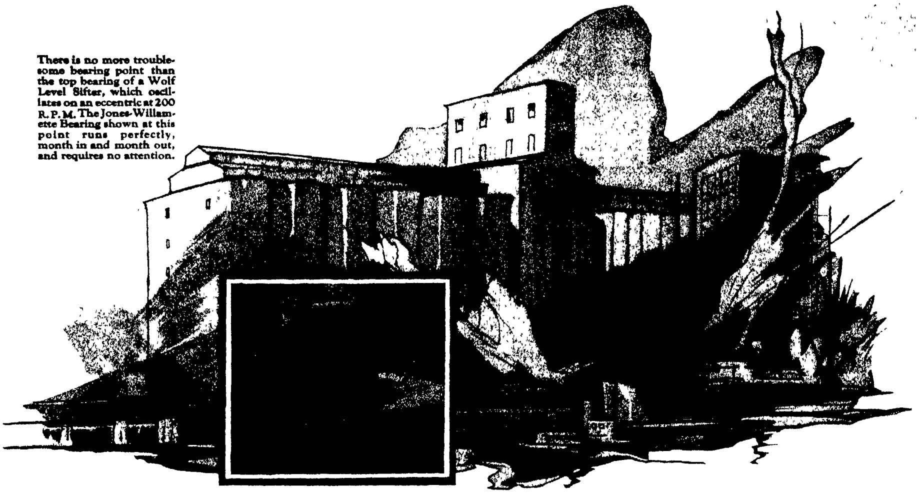
Next month we shall publish the answer Perhaps in the meantime some of our readers will send in the correct one

PROGRESS

BY July 1 the population of Continental United States will be 117,136,817 the Census Bureau estimates. This will be an increase of 11,426,197 since the last Federal enumeration in 1920

A gain of a million and three quarters is recorded since last July

Growth, yes But does that mean progress? The report of another bureau the Patent Office may shed some light on that point Commissioner Robertson states that last year 46,560 patents were issued, a gain of 3,986 over 1924 and the greatest number issued in the history of the country All the signs point to a still higher record next year.



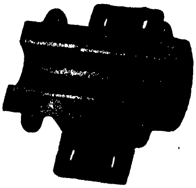
There is no more troublesome bearing point than the top bearing of a Wolf Level Sifter, which oscillates on an eccentric at 200 R. P. M. The Jones-Willamette Bearing shown at this point runs perfectly, month in and month out, and requires no attention.

Flour mills can eliminate costly shutdowns and oil damage to product *by installing Jones-Willamette Bearings*

There is no place where a full equipment of Jones-Willamette oil-tight, oil-sealed bearings is more important than in grain milling industry. Oil leakage into the product in process must be prevented or heavy losses ensue.

But the advantage of Jones-Willamette Bearings are not limited to this one feature. They eliminate costly shutdowns, due to bearing trouble. They cut the labor and attention mill machinery requires, put lubrication on a weekly or monthly instead of a daily basis, and consume only pints of oil where gallons have been used before. Furthermore, the power saving due to decreased friction drag in machinery and transmission lines is another important economy which follows Jones-Willamette installations.

These bearings are now available in standard and special types to fit the requirements of every industry. If you are a user of bearings you should inform yourself regarding this development. One or two Jones-Willamette bearings installed in your plant will give you a new idea of bearing efficiency. . . . . Write for engineering data and descriptive literature.



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THE LATE LUTHER BURBANK IN THE VIRGIN FORESTS OF THE CALIFORNIA MOUNTAINS

Prodigal Mother Nature

By Cross-breeding and Persistent Selection the Plant Breeder Speeds Up Nature's Slow, Wasteful Hit-or-miss Methods of Producing New Species a Thousand-fold

By Luther Burbank

INTIMATELY observed over a long period, Mother Nature is revealed as a spendthrift and almost careless old lady, wasting and throwing her treasures about with the opulence of a mining man on a spree.

Every living thing under her care produces hundreds, thousands or even millions of the seed of its own kind—so many, as has often been remarked by scientists, that if any considerable share of them germinated, grew and developed, they would overcrowd the world with one species in a short period. Yet we know that Nature has a reason for everything she does, if we look far enough, and we are compelled to search here for the reason.

Whenever you dip into any of the sciences that are founded on or are akin to biology it is necessary to go back to the one master, Darwin. He found the reason, although he did not state it in so many words in this connection. His law of "the survival of the fittest" is the basis for an explanation of our puzzle.

Nature's Wastefulness Useful

Only the fittest survive, in the end, as long as we leave Mother Nature alone, or when we use intelligence and skill in assisting her; her prodigality, therefore, makes possible an almost infinite number of seeds, so that the death or what we might call the murder of the weak may occur again and again—hundreds of thousands of times in one generation—and after the massacre is over, there will still be a few strong individuals to carry on the line. The very fact that these survivors are the plucky and hardy ones of the family necessarily tends to improvement in the species.

There are two factors which have entered into the scheme of things to make this original and natural prodigality of Nature's seem, at first glance, unnecessary and even superfluous. Of course, she does not change to accommodate herself to new conditions—for she is unchanging in her laws—and we shall see presently that it is a good thing that she has not abandoned her prodigal ways, and that apparently wasteful production of seeds and seedlings are actually useful to man still. She was reckless in producing seeds because she could afford to be, with plenty of raw material in the plants and with plenty of time in which to work her gradual changes and developments in her children.

"Wizardry," or Taking Infinite Pains?

What was that magic by which the late Luther Burbank produced new kinds of fruit, new vegetables, new flowers? In the main, what Burbank did is what most of us might do if we would first make a profound study of Nature's ways. Yet, even should we do this, could we be sure of duplicating Burbank's successes? It is unlikely, for we are not Burbanks. This is only another way of saying that few of us exhibit that willingness to take pains that defines "genius," or the rare aptitude which Burbank had for making accurate observations and reasoning correctly from them. Perhaps, however, what we most lack is that elusive something which Mr. Burbank called "intuition." After all, then, was he not a kind of wizard?

The first of the new factors in the scheme were birds and insects. It is calculated that more than 240,000 new species of plants came almost suddenly into existence when bird life and insect life, especially the bees, were evolved. Birds and bees and other insects sought food, and in their busy scurrying from fruit to fruit and from flower to flower they carried pollen that caused crosses to begin to appear, crosses which resulted in the incidence of new species. I say almost suddenly, although of course, I mean that only relatively. Generally speaking, the development was very slow—by what Darwin called "slow variations." But, looking back down time from this distance, it was sudden. For the birds and bees accomplished in a hundred years, perhaps, what it would have taken Nature ten thousand years to do with her old careless, hit-or-miss fashion of using winds and floods and accidents to effect crosses.

Only Persistent Selection Brings Success

The second factor in speeding up Nature's processes and making her prodigality seem unnecessary was man. Plant breeding is a comparatively new science, but soon after man emerged from his primitive condition he accidentally brought about crosses by throwing strange heredities together, and by a selection that he was not conscious of, he developed better or different varieties. He knew no science of plant breeding. It is doubtful if he ever realized that he was by his own acts improving strains. Nevertheless, that is what he did do, so that new species were gradually created while the old wild parent-species were still to be found following Nature's methods and improving themselves by age-long processes.

Darwin believed that the formation of species came only through those slow variations mentioned above, but for some time now we have realized that there are comparatively swift and sudden methods of species-forming. In short, plant breeding has developed into a practice, and as we learn more and more about the underlying principles of the art, we realize that it is beginning to be fixed as a science.

To make clear what I desire to set forth, it must be pointed out here that what we call species are merely aggregations—bundles of individual plants, no two of which are exactly alike but most of which resemble one another closely enough in outside appearance and in hereditary tendencies to be roughly divided into species. However, this is only an empirical classification we practice. Beginning with these aggregations of plants, divided off into species, we can effect crosses that will combine them, although it cannot be predicted what may result from such crossing any more than one can predict what will happen to the second-generation plant when the parent plants are subjected to any other disturbing pressure from without.

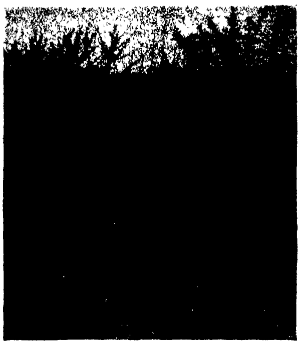
There are no rules yet laid down as to the combining of various hereditary characteristics in plants. The chemist can tell fairly accurately what will occur when he compounds two or more chemicals, but the plant breeder cannot. This is because there are ten thousand heredities bound up in one plant, instead of, as in chemicals, a one-track and changeless heredity.

However, we have discovered that there is a method by which, when another step is taken, the plant breeder can tell almost exactly what result he will get; not only that, but he can be the architect of this work. By taking this step, he can plan accurately and closely what he wants to build in plants and then he can carry out his plan with a well nigh mathematical accuracy. That step is *persistent selection* in a given and very definite direction and with a definite aim never lost sight of nor abandoned.

More than "Book-learning" Needed

In the first generation after the cross-breeding of two heredities we generally find a more or less complete blending of all the characteristics of both parents, not only in outward and visible respects, but in the innumerable invisible ones that are inherent and that are certain to affect the plant, but that cannot be determined until growth has developed the plant and until selection and reselection has eventually fixed the characteristics which we desire. This might almost be called a fundamental educational process extending through successive generations, each of which is given a certain impression until those impressions have registered, almost as on a sensitive film, and become an ineradicable picture.

And so, after birds and insects had cut Nature's time down from ten thousand years to a hundred, man came along and cut the time required by birds and bees to a few years. He was able to do this, you will see, because the birds and the bees moved by instinct—and incidentally while actually engaged, as far as they themselves went, in getting food—while man has brought his intelligence to bear on the problem and now uses experience, study, experimentation, thought and definite work to aid him.



NEW SHRUBS IN THE MAKING

Selected individuals of ornamental shrubs being developed as new varieties by breeding and selection

I said above that plant breeding has developed into a practice and that it is beginning to formulate laws and formulas which bring it very close to a science. But the personal equation still enters too largely into plant breeding for rules to be laid down and a technique established that will enable anyone to study the subject in college and then go out and perform its miracles. The plant breeder, before making combinations, has to use the greatest care, based on a wide experience, to select the individual plants which seem best adapted to his purpose.

The differences in the individuals which the plant breeder has to work upon are sometimes extremely slight. The ordinary unpracticed person cannot by any possibility discover the exceedingly minute variations in form, size, color, fragrance, precocity and a thousand other characteristics which the practiced plant breeder perceives with one lightning glance. The work is hard and exacting, requiring an exceedingly keen perception of minute differences, great practice, and extreme care in treating the organisms operated upon. Even with all the naturally acquired variations added to those secured by scientific crossing and by numerous other means, the careful accumulation of slight individual differences through many generations is imperative. And after that several generations are usually necessary in order to "fix" the desired type for practical purposes.

It will be clear then that plant breeding is still only in the beginnings of its possibilities; selection is so nice and so delicate a task that the best of us must necessarily fail and blunder and miss great opportunities. It is this fact that leads us back again to the point from which we started. It brings us to Nature's prodigality, and what I wrote concerning the advantage to mankind that is still to be found in what appears casually to be a wasteful production of seeds and seedlings and new growths from old parent stems. For there have been countless instances in the experience of every plant breeder where he knows he must have missed new and valuable discoveries.

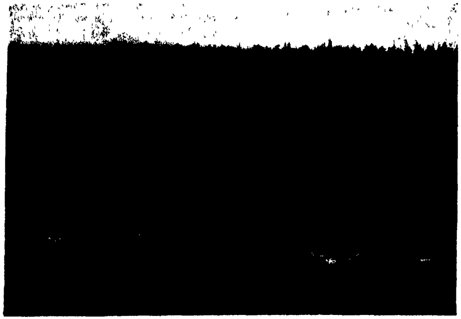
My development of the Burbank potato, many of my plums, and thousands of other productions have enabled me to be of service to mankind, but I have often thought:

"Among all the varieties that Nature so prodigally produces and sets before me for selection and experimentation, how many great gifts of hers to man have I missed?"

Many Variations Lost

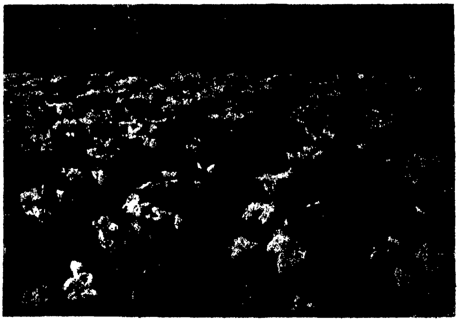
No doubt for every chance grasped there have been innumerable chances lost. It is so through all the history of plant breeding by selection. The Bartlett pear, the Baldwin apple, and the navel orange were all variations selected by some keen observer. But at the same time, think of the millions and millions of other variations that have passed unnoticed and have been lost to men and buried in oblivion forever for the lack of such an observer or because the observer passed them by!

For this our single consolation lies in the prodigality of Nature. She can produce almost without limit, and she continues to do so, and thus those variations we have missed, or others just as valuable to man, may recur and recur until they are caught and fixed. Our duty is to go on studying in her school and then, here and there, now and then, sometimes by intuition and sometimes by intention and sometimes by mere fortune or accident, we will continue to pick up from her treasures valuable varieties that will continue to make the world a better and a better place in which to live.



A FIELD OF ORNAMENTAL SHRUBS

From this large experimental bed the plant breeder will choose individuals that will carry on his work for a new variety



LILIES AND POPPIES IN PROFUSION

These millions of seeds may furnish the plant breeder with forty or fifty that he may consider using in further developments

How to Observe the Great, New Sun Spots

By Henry Norris Russell, Ph.D.

Professor of Astronomy at Princeton University. Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

FOR the last year or two, the number of sun-spots has been rapidly increasing, and their size as well.

It is not an unusual occurrence now for a spot—or at least, a spot group—to be large enough to be seen with the unaided eye. "Unaided" is rather a misnomer, for no sane man would think of looking at the sun without some protective device, either the old-fashioned smoked glass or the more modern piece of densely fogged film. But, for the larger groups, no magnifying power is necessary. A good field-glass shows far more of the spots, provided that care is taken to hold the shade-glass directly in front of the eye, and not in front of the objective of the field-glass (in which case all its optical defects are correspondingly magnified). With this simple equipment, the amateur may see the spots and observe their stately progress across the sun's disk from day to day as the rotation carries them onward. He must be on his guard in one matter: as the diurnal motion of the heavens carries the sun across the sky, different points of its rim appear to be at the top.

Sun-spots are short-lived affairs and even the largest of them usually endure for only three or four months at best. Yet, although they are almost as short-lived as storms, they resemble storms in another way—they are far more likely to occur in some latitudes than in others.

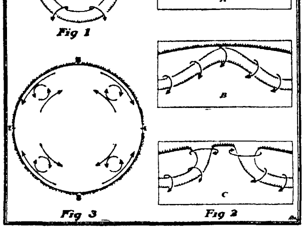
The Cycle of Sun Spots

Spots are hardly ever found more than 45 degrees from the sun's equator, and few of them are beyond the 35th parallel of solar latitude Spots close to the equator are also rare—although not unprecedented. When, as at present, their numbers are increasing toward the maximum, they occur in two fairly sharply defined zones on each side of the equator, extending from about 15 degrees to 30 degrees of latitude, with a practically clear region nearly a quarter of a million miles wide, between them.

As the activity of the sun increases and new spots appear in increasing numbers to replace those which die out, the spotted zones widen, on the side toward the equator, until the vacant area between them becomes narrow. Then, after the maximum, the zones shrink on their outer edges, few or no new spots appearing in high altitudes to take the places of those which fade out. Finally, when the action has almost died down, the spots are practically confined to the region within 10 degrees of the sun's equator. Before the last traces of spot-activity have vanished here, spots belonging to the new cycle break out between 25 degrees and 30 degrees from the equator in new spot-zones, more than 400,000 miles apart. These zones widen as the number of spots increases, and so the cycle goes on. This remarkable behavior—known as "Spoerer's Law," after its discoverer—is of much importance, for it indicates clearly that the sun-spots are only symptoms of some deep-seated disturbance, involving a great portion of the sun.

There is plenty of other evidence now in favor of this belief. The work of Hale and his colleagues —which is too well known to need rehearsal here—has made it clear that the spots are vast ascending cyclonic storms on the sun's surface, in which the gases whirl upward and outward, in a direction exactly opposite to that of water running out of a wash-basin. The enforced expansion of the gases as they come to regions of lower pressure cools them, accounting for the darkness of the spots and many peculiarities of their spectra, while the gyratory motion, in some ways—still imperfectly understood —is connected with the production of the powerful magnetic field whose existence is detected by spectroscopic means.

Sun-spots usually appear in pairs, two large spots, lying almost east and west from one another, with sometimes a string of small attendants. In such a case, the leading and following spots—counting them in the direction of the sun's rotation—are practically always of different polarities, as shown by the magnetic effects, that is, the cyclonic whirls are in opposite directions—right or left-handed, as the case may be. In the northern hemisphere of the sun, and for years at a time, the leading spot shows almost always the same direction of rotation, and the following spot, the opposite one. Meanwhile, on the southern hemisphere, the direction of both whirls is reversed This is not surprising, for in cyclonic storms on the earth, the direction of revolution is opposite on the northern and southern hemispheres. But a really remarkable thing happened in 1912, when the spots of one cycle were dying out near the solar equator. As soon as those of the new cycle appeared in high latitudes, it was found that the polarities were reversed and the directions of revolution for the preceding and following spots were just the opposite of what they had been before in the same hemisphere. Whether this was a general rule could not be tested until 1924, when still another cycle began. The reversal of polarity occurred again and it now appears highly probable that it is to be expected with each new cycle



THE BJERKNES THEORY OF POLARITY CHANGE

The several phases of sun spot phenomena depicted here are explained in the text of Professor Russell's article

This is not easy to understand. It is evident, as Hale has recognized since the first detection of the spot-vortices, that the two members of a "bipolar" pair must be connected in some way. The most obvious suggestion was that they are the two ends of a U-shaped vortex (much like that which may be produced by drawing an oar-blade through the water). Such a vortex is roughly illustrated in Figure 1, in which the arrows indicate the direction of rotation. It is obvious how, although the direction of rotation is really the same all along the deep-seated vortex, it appears to be opposite at the points where the two ends of the U-shaped whirl come to the surface.

This conception accounts very nicely for the bipolar character of the typical group: but it does not fully explain why all such groups in a given hemisphere should rotate in the same direction. Moreover, it meets with another difficulty There is a powerful flow of material out from the ascending funnel of the vortex at each end, sometimes for months continuously Where does all this material come from, if the vortex is no longer than is indicated in the spectra? And why should spots vanish and break out again in nearly the same place?

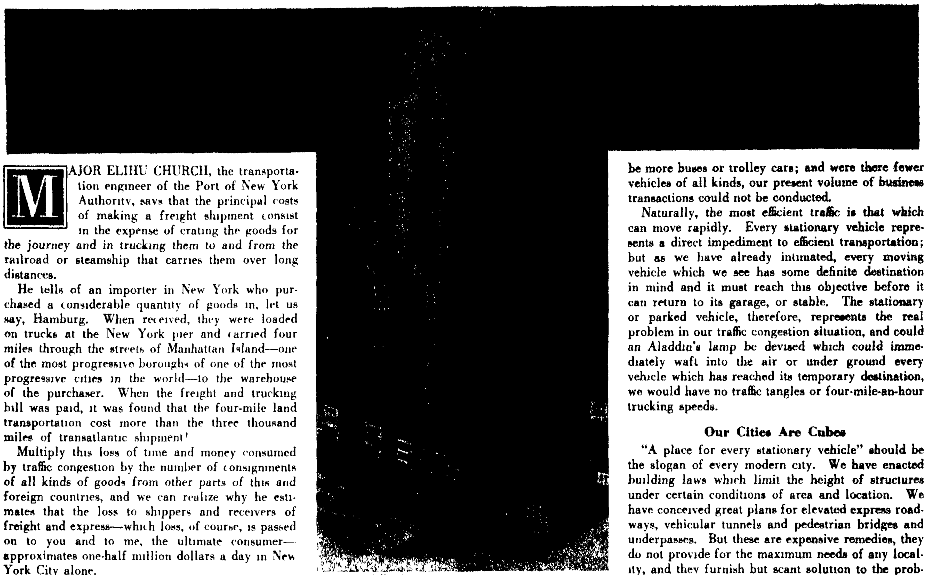
These questions, and the more puzzling one of the change in polarity from one cycle to the next, appear to be well answered by a suggestion which has been recently made by the distinguished meteorologist, Bjerknes. According to this, the primary vortex to which a spot-pair is due lies ordinarily below the sun's surface, and forms a ring extending clear around the sun, parallel to the equator. All along this vortex the material is evolving about its central line, just as the gases do in the familiar smoke-rings. Usually the whole affair is buried too deep to see, but at times it bends up and works out to the surface, as illustrated in Figure 2 When it does so, it produces a pair of spots, with their superficial rotation in opposite directions, but now, instead of having only a short strip of vortex between the spots to feed the escaping currents of gas, a huge vortex, extending all the way around the sun beneath the surface, is available and it may be that, before the spot-pair disappears, material which was originally hundreds of thousands of miles away may work out to the surface

A New and Notable Advance

When the visible activity dies down, the severed ends of the vortex probably unite, leaving it still in existence under the surface, perhaps to gain energy and break out once more, in the same place or elsewhere Wherever it does so, the polarities of the preceding and following spots will be the same as before

But why should these reverse with a new sun-spot cycle? Bjerknes suggests that the still deeper-seated cause may be a slow drift of the material of the sun toward or away from its poles Figure 3 is supposed to be a cross-section of the sun, with the poles at N and S, and the equator at EE If there is a deep-seated drift toward the poles and a superficial one toward the equator, then, where one drift merges into the other, there will be a tendency for whirls to form, as indicated by the curved arrows—and these whirls are evidently exactly what a vortex-ring extending all around the sun would exhibit when cut in cross-section by a plane through the poles. There might be several of these vortices at different latitudes All those in the northern hemisphere would rotate in the same direction, and when they broke out to the surface, would give spot-pairs of the same polarity, while the vortices in the southern hemisphere would rotate in the opposite direction. So long as the underlying drift at the surface continued toward the equator, this situation would last If, however, this died out in time, and the poleward drift took its place (with a return drift towards the equator deep down) a new set of vortices would come into existence, every one of which would be reversed in its rotation, compared with those of the last cycle in the same hemisphere.

Although much, of course, remains to be done, this suggestion explains so much that was previously unaccountable that it may well be hailed as a notable advance in the interpretation of solar phenomena.



Drawn by Arthur I. Merrick

THE THIRD DIMENSION

Forty times as many tenants occupying a given site—but no additional space for vehicles to approach that site

MAJOR ELIHU CHURCH, the transportation engineer of the Port of New York Authority, says that the principal costs of making a freight shipment consist in the expense of crating the goods for the journey and in trucking them to and from the railroad or steamship that carries them over long distances.

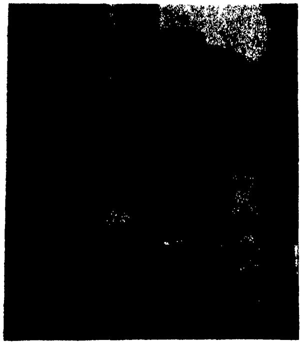
He tells of an importer in New York who purchased a considerable quantity of goods in, let us say, Hamburg. When received, they were loaded on trucks at the New York pier and carried four miles through the streets of Manhattan Island—one of the most progressive boroughs of one of the most progressive cities in the world—to the warehouse of the purchaser. When the freight and trucking bill was paid, it was found that the four-mile land transportation cost more than the three thousand miles of transatlantic shipment!

Multiply this loss of time and money consumed by traffic congestion by the number of consignments of all kinds of goods from other parts of this and foreign countries, and we can realize why he estimates that the loss to shippers and receivers of freight and express—which loss, of course, is passed on to you and to me, the ultimate consumer—approximates one-half million dollars a day in New York City alone.

Cost Measured by Time

But New York is not necessarily any worse in this respect than others of our so-called thriving, hustling cities. We are merely citing this metropolis because it suffers from a combination of all the transportation ills which modern conditions of living and business congestion have brought upon other growing cities.

Of course, the city forefathers of New York, when they first laid out the comprehensive plan of highways and streets on the island of Manhattan, could not conceive that rail and motor transportation would convey all our traffic north and south, instead of toward the two waterfronts—which, in those days, represented the only available means of local and distant traffic. Consequently, streets leading toward the waterfront are about three times as frequent as those running north and south, which must constitute the main arteries of the island.



Brown Brothers

ONE REASON FOR SLOW TRAFFIC

Rear wheel-to-curb truck delivery congests traffic

The old saying that time is money was never so well illustrated as in the case of transportation delay. A motor truck is economical when it can work at high capacity, and at comparatively high speed. Cut down that speed to a crawl, and it represents no advantage over a horse, or even a push-cart for that matter. But insurance, drivers' wages, interest on investment and other items continue whether that truck is moving or standing still. The Major estimates that the minimum cost of such a truck is six cents per minute, whether traveling at zero, or at fifteen miles an hour, and declares that "the cost of trucking is measured by time, not distance."

This same engineer has also discovered that the average waiting time of each truck—motor-driven or horse-drawn—at piers and at other shipping terminals, is 68 minutes, including 14 minutes loading and unloading time. Furthermore, because of this waste of time, the average load carried is only one and one-half tons. Is it any wonder then that freight can be hauled by rail from New York to Buffalo for approximately the same cost as that of two or three miles delivery transportation charges to its warehouse or other consignment point in the city?

Automobile owners no longer go "pleasure riding" in the city. Every vehicle which we see on our streets represents a medium of transportation—usually necessary. Were it not for the private passenger cars, there would be a greater number of taxicabs. Were there fewer taxicabs, there might be more buses or trolley cars; and were there fewer vehicles of all kinds, our present volume of business transactions could not be conducted.

Naturally, the most efficient traffic is that which can move rapidly. Every stationary vehicle represents a direct impediment to efficient transportation; but as we have already intimated, every moving vehicle which we see has some definite destination in mind and it must reach this objective before it can return to its garage, or stable. The stationary or parked vehicle, therefore, represents the real problem in our traffic congestion situation, and could an Aladdin's lamp be devised which could immediately waft into the air or under ground every vehicle which has reached its temporary destination, we would have no traffic tangles or four-mile-an-hour trucking speeds.

Our Cities Are Cubes

"A place for every stationary vehicle" should be the slogan of every modern city. We have enacted building laws which limit the height of structures under certain conditions of area and location. We have conceived great plans for elevated express roadways, vehicular tunnels and pedestrian bridges and underpasses. But these are expensive remedies, they do not provide for the maximum needs of any locality, and they furnish but scant solution to the problem of the stationary vehicle.

We must go directly to the source of this difficulty to find its solution. What has produced our traffic problem? It is the *concentration* of business and living. Our cities are no longer planes, having but two dimensions; they are *cubes*. We have entered the third dimension with a vengeance in our business and city dwellings, and yet we expect the same two-dimension highways to take care of our moving and stationary traffic.

Let us consider a concrete example. You have moved into a fine new office building of which you are justly proud. It may occupy a half or a full city block—say a block 200 feet square. It occupies

Brown Brothers

A BRIDGE FOR PEDESTRIANS

The space beneath is free for vehicular traffic

a street on which once stood 30 or 40 brownstone dwellings each housing a typical American family, or probably a total of 150 persons for that block. But in your office building, occupying exactly this same space, there may be 5,000 fellow tenants and office workers. You and they must go daily to and from this building. You are all engaged in business of some sort, and your customers must come and go. You must be supplied with office necessities, goods to sell, and with heat and food. Therefore, the traffic made absolutely necessary by that building facing on 800 feet of street space would supply a village of three or four thousand inhabitants; ***but there is not one foot more of curbstone or parking space to meet these supply requirements than was the case in the brownstone front days when each family was supplied with 20 or 30 feet of sidewalks in front of its own private property!***

City Planners Lacked Foresight

On all four sides of this building the same conditions either have already been reproduced, or will be in the near future, if our present urban viewpoint continues. Our City Planning Commissions, for the most part, have been sadly lax in foreseeing these conditions. They have permitted the erection of veritable hives of apartment dwellers and office workers, but have made no provision for compelling the solution of the traffic and transportation problem which these new building conditions create. True, some modern buildings have been constructed with street-level arcades cut under the building to furnish vehicular space to what would normally be the building line, and to provide pedestrian space actually within the building proper.

As a supplement to this system however, we should provide parking facilities for every vehicle brought to that vicinity by the increased requirements of the building occupying the space in question. In designing a modern building, the architect devotes a certain percentage of its otherwise available rental space for the vertical transportation of its tenants in the form of stairways, elevator shafts, and fire escapes. But he must do more. The owner of a modern building should be glad to devote at least five per-cent of its profitable space to the temporay storage of the vehicles which the business or social activity of the occupants of that building brings to its immediate vicinity.

What would we think of a railroad which undertook to serve a thriving city and yet did not provide freight yards, passenger depots and other facilities to care for the temporarily stationary traffic? We would tell that railroad that it must buy land and provide space in which the contents of passenger and freight trains could be discharged, or taken on, without interfering seriously with the remainder of the traffic service which that corporation was supposed to furnish.

We cannot well redesign our cities, and distribute centers of business activity over a larger area. Business of one kind gravitates to a certain section and concentrates there. We have already stated that this growth can only be upward to the third dimension, and that the solution for this parking problem must also be found within this same dimension.

A Problem That Needs Solving

Every man, woman and child in every large city in the country is paying approximately two hundred and fifty dollars a year that would not have to be paid if freight were handled efficiently.

The street traffic muddle is the one outstanding problem facing city plan engineers. Building laws have been passed to limit structures to certain heights, areas and locations. Elevated and subway tracks, vehicular tunnels and pedestrian bridges and underpasses have been devised. All of these together, however, will not suffice. Our business and living quarters are becoming more and more congested, more and more motor cars are crowding our streets, and more streets are impossible.

Mr. Slauson makes an interesting proposal. Will it prove a solution? At any rate it is worth consideration.

This required parking and delivery area cannot well be obtained from open space which is otherwise available for building construction. It is nonproductive of revenue in the same manner as hallways and stairs offer no rental return. Also the ground floor of any building is, as a rule, its most valuable portion. But present-day buildings are constructed with three, four, five and even six cellars or sub-basements in which fuel and other supplies are stored, and in which the necessary machinery for the operation and upkeep of the building is located.

The first of these otherwise nonproductive sub-cellars could be connected with the street by means of a wide ramp, or sloping roadway, as is typical of modern garage construction. In the sub-cellar thus made available, could be stored all cars and other vehicles, the owners or drivers of which have occasion to transact business within the building in question beyond a certain definite time, such as one-half hour In this sub-cellar also all deliveries for the building in question could be made, and easy connection with the freight elevators obtained.

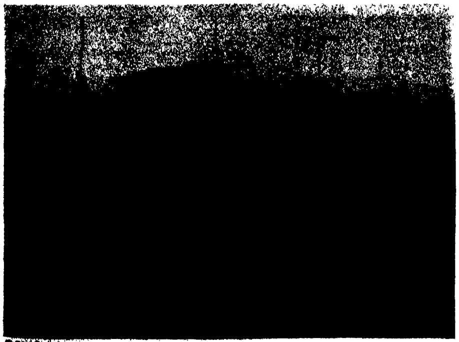
One of the most serious impediments to modern traffic in our average city is the long wheelbase truck which is backed to the curb and which overhangs partially across the sidewalk, for the purpose of street-level delivery to these improperly constructed buildings With street space so valuable, and with traffic congestion so serious, in case of a severe fire in such a congested area, this practice of rear-wheel-to-curb truck delivery should never be permitted.

Would This Plan Be Feasible?

Such a plan would, of course, add somewhat to the cost of building construction and maintenance. It could, however, be assessed partially against the tenants who made use of such a service which would keep their cars under observation, protected from bad weather, and available at any moment. This personal convenience, however, is not the primary object of this plan, and its light cost is borne by the tremendous saving which would follow through the increased speed of traffic and the restoration of city streets to their original purpose of highways for *moving* traffic.

It should, of course, be understood that such a plan is recommended only as a part of the zoning laws of our various cities, and that it is to apply only to such buildings whose height, size, and nature of use create a large amount of vehicular traffic in their vicinity It might not, for example, need to be applied to buildings under ten stories in height, and certainly not to those public institutions surrounded by parks, plazas, and other space providing adequate parking area

For department stores, hotels, and office buildings, in areas of narrow streets and congested traffic, however, the solution of this parking problem within the building itself—the creator of that congestion—is of vital importance to the safety, utility, and efficiency of our transportation system, not only of the future but of the immediate present. And it is upon transportation that our living, enjoyment, and efficiency largely depend



CONGESTION ALONG THE LOWER HUDSON RIVER

When one visits the docks of steamship companies along New York harbor, one has some realization of the vast amount of domestic and foreign goods which must be carried away

International Newsreel

THE "SPIDER" MAY SOLVE BERLIN'S TRAFFIC PROBLEM

Dr. Malberg, official architect of Berlin, has made a model of a traffic plan which consists of a platform elevated over the street level In the center is the entrance to the subway

The Internal Heat of the Earth

The Center of the Earth—What We Know of Its Temperature, Structure and Its Composition

By Frank Wigglesworth Clarke
Chief Chemist, United States Geological Survey, Retired

THAT there are high temperatures within the earth has been known since the beginning of civilization. The testimony of active volcanoes was definite and conclusive. To mediaeval philosophers volcanoes were the chimneys of hell, which, as everybody knew, was situated somewhere beneath us, and streams of molten lava proved it to be a fit abode for heretics and other less dangerous sinners.

Hot springs gave similar, but much milder information. What could be clearer or more satisfactory? There may have been other attempts to explain volcanic phenomena, but if so, all were qualitative. The evidence on which to base quantitative explanations was yet to be discovered. How hot is the interior of the earth, and how is the heat distributed? To answer these questions many lines of evidence now converge.

Theory Run Rampant

The simplest line of attack upon the problem before us is found in the study of deep mines and wells in which the temperature gradually rises as we descend. The rate of increase is not the same for all localities, but ordinarily ranges from one degree, Fahrenheit, in every 50 or 60 feet of depth. The deepest bore hole yet driven is only about a mile and a half deep. From this it is a long journey to the center of the earth, nearly 4,000 miles away.

Nevertheless, attempts have been made to take that journey mentally, and curious results have been reached. By various methods of extrapolation, all of them based upon the assumption that the observed increases of temperature continue to the center of the earth, temperatures have been computed for the latter point in many thousands of degrees, so many that the temperature of the centrosphere should exceed the critical temperatures of all known elements which, if not actually decomposed, would form a vast pseudo-gaseous mass quite unlike anything of which we have any real knowledge. The temperature of the sun would be exceeded many times, a conclusion which seems very much like a *reductio ad absurdum*. This line of attack upon our problem needs no further consideration.

Is the Earth's Interior Molten?

Man has never been able to penetrate much more than one mile beneath the earth's surface—a mere pinprick. Yet, while science does not claim positive assurance regarding the actual conditions in the earth's inner layers, there are certain things about it which we know are not so. One is that the earth's interior is a molten liquid. Probably nothing has tended so strongly to crystallize this widespread misconception as the existence of volcanoes, pouring out liquid lava. In the earth's center, however, the pressure is too great for the rocks to melt. Thus, they are as rigid as steel. The seismologist can easily prove the latter statement, for he records earthquake shocks that travel through the earth's interior; and it is the characteristics of these shocks that prove the earth's interior to be rigid. Volcanoes are held by the majority to be of local, not deep-seated origin.

In order to reach any definite conclusions relative to the heat within the earth we must begin by considering the earth itself as a whole. Its dimensions are well known, its mass has been determined, its mean density established, and its rigidity shown to be at least equal to that of steel. It is a solid body, it behaves like a huge magnet, and in many respects it resembles an enormous meteorite.

Meteorites fall into two principal classes, those consisting mainly of an alloy of iron and nickel, the other mainly of stone. Between these classes there are many intermediate forms, irons enclosing stony matter, and stones containing more or less iron.

The stony meteorites are composed of minerals such as are found in igneous rocks, and which, being crystalline, must have solidified from a state of fusion. The irons also, as shown by their peculiar crystalline structure, must have originated in the same way. It is now generally believed that meteorites are fragments of a body of sub-planetary dimensions, although the cause of its disruption is unknown. The close similarity between the broken planetoid and the earth seems to be very clear.

The mean density of the earth is about 5.5 or a little higher. That of the igneous rocks in the accessible portions of the crust is not far from 2.75. That is, the earth as a whole is twice as heavy as it would be were it composed of substances such as form its crust. To account for the difference, there must be heavier substances within it, presumably metallic, and mainly, in all probability, of nickel-iron. The outcrop of iron in basalt near Ovifak in Greenland resembles meteoric iron in all essential respects, although it is clearly terrestrial. Is it a sample of the centrosphere, the nucleus of the earth, left stranded when our planet cooled?

A Core of Solid Metal

That the earth was once a molten mass is generally admitted by geologists and geodesists. Its outermost shell, except for a thin layer of sedimentaries, is composed of igneous rocks, granitic near the surface, and shading off into heavier ferromagnesian rocks beneath them. For present purposes the ocean and the atmosphere can be ignored. Their influence upon the mean density of the earth is insignificant. The centrosphere, as suggested in the preceding paragraph, is a heavy, metallic, rather irregular spheroid of density not far from 7.8. These conclusions are supported by a great mass of evidence, which can only be briefly summarized. They bear upon the problem of internal temperatures.

In the cooling globe the nickel-iron separated from its rocky envelope, just as iron does from slag in a blast furnace. The separation was not perfect,

Courtesy of the Department of the Interior

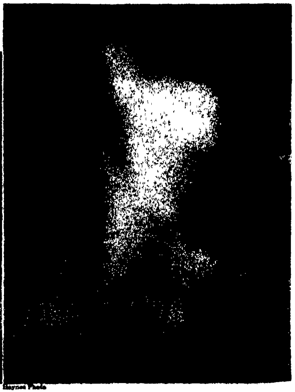
GIANT GEYSER, YELLOWSTONE PARK

Geysers are doubtless of relatively superficial origin

Brown Brothers

LAVA FLOWS, MT. KILAUEA, HAWAII

Their temperature is only about 1,800 degrees


Haynes Photo

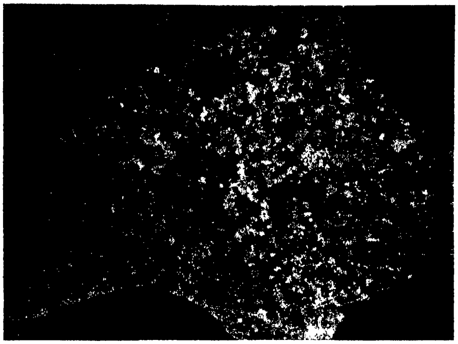
"OLD FAITHFUL," YELLOWSTONE PARK

When the pressure is lowered, the water flies into steam

Courtesy of the American Museum of Natural History

THE LONG ISLAND METEORITE

It is the largest aerolite or stone meteorite known, all the fragments aggregating 1,325 pounds It consists essentially of a kind of pyroxene, olivine and chromite



THE WILLAMETTE METEORITE

This meteorite fell in Oregon A section has been polished to show the Widmanstatten lines of the metal This is a siderite, consisting essentially of nickel and iron

of course, but very nearly so. The nucleus of the earth would contain stony inclusions, like meteoric iron, and some iron would remain entangled in the rock. By two distinct methods the relative volume and masses of centrosphere and lithosphere can be estimated, and values having a high degree of probability can be obtained. Weichert, from a study of earthquake waves, found that the centrosphere and lithosphere are very nearly, if not quite, of equal volume. From the relative densities of the same components we can compute the proportions needed to give the mean density of the earth, and the equality of volumes is confirmed. The two methods lead to the same conclusions, and the margin of error is not large.

It is not necessary here to go into details of the computations. According to Weichert the diameter of the metallic nucleus or centrosphere is of the order of 10,000 kilometers or 6,214 miles, to which a thickness of its rocky envelope of 855 miles corresponds. The figures deduced from the densities are 6,192 miles for the nucleus and 863 miles for its envelope. A better agreement could hardly be expected.

Old Heat and New

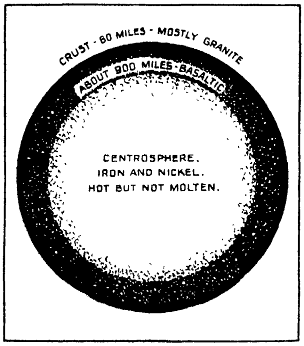
Now, with some notion as to the internal structure of the earth, we are in a position to discuss the distribution of heat within it. That heat may be considered under two headings; first, the residual, or original, heat retained by the cooling globe, and second, the new heat which is being continually generated in the outer zones of the lithosphere. This distinction is perfectly clear, although it seems to have been commonly neglected heretofore. What are the sources of the new heat? The question is fundamental.

Three principal sources of new heat in the crust of the earth are easily recognized; namely, friction, chemical reactions and radioactivity. The possibility that there may be other sources may be left out of account. That friction is an important source of heat within the lithosphere is evident. The crust of the earth, to a depth of many miles is in constant motion, and every tremor generates heat. Mountains are lifted up, strata are broken, bent, folded, or distorted; there are landslides and erosions, and earthquakes, great or small, are frequent; and everyone of these movements is a source of new heat.

Volcanic activity, which appears as a rule along lines of weakness in the crust of the earth, is commonly associated with earthquakes. Part of it, however, is due to chemical reactions, such as the combustion of heated hydrogen when it comes in contact with air. This heat, so far as it is generated during an eruption, is lost by diffusion into the atmosphere.

Volcanism, however, is not a very deep-seated phenomenon, the seat of its activity is less than ten miles, perhaps not more than five, below the surface of the earth Volcanic temperatures, furthermore, are not extremely high At Kilauea the temperature of the lava pool is only about 1,000° C. (1,832 degrees, Fahrenheit). Even if this figure is exceptionally low, all the evidence now available indicates that volcanic temperatures do not exceed 1,600° C (2,912 degrees, Fahrenheit).

Apart from volcanism, chemical activity in the crust of the earth is manifested in many ways. Igneous rocks are altered into metamorphic forms, and new minerals are produced, each one the result of chemical reactions. Olivine is altered into serpentine, hornblende into talc, beds of pyrite into limonite, and feldspar into kaolin Each of these reactions has thermal significance, whose magnitude we cannot yet determine.


CRUST - 60 MILES - MOSTLY GRANITE
ABOUT 800 MILES - BASALTIC
CENTROSPHERE. IRON AND NICKEL. HOT BUT NOT MOLTEN.

THE EARTH IN CROSS-SECTION

The crust is relatively thin. Beneath it are heavier rocks Contrary to popular belief, the earth's center is not molten

Chemical activity, however, is probably not deep-seated, but is limited to that part of the crust which can be reached by the three great reagents, namely, water, air and carbon dioxide. The deeper layers of the lithosphere are probably anhydrous

Many, perhaps all, of the igneous rocks are radioactive, and radioactivity generates heat According to some authorities, especially Professor Joly, this source of heat is large enough to account for all the heat in the lithosphere, but, it seems to me, that is not yet completely proved. The distribution of radium in the igneous rocks needs to be studied.

Taken altogether, the three sources of new heat are certainly adequate to cover the entire field deep wells, hot springs, active volcanoes, and heated rocks.

But are they operative below the zone of isostasy? In that zone the continually shifting pressures must generate heat by friction, but below it, that is, below a depth of 60 miles, we have no positive knowledge. In the depths of the lithosphere the heat is probably all residual—which remains to be proved.

Earth's Core Not Very Hot

With the evidence before us, what conclusion can now be reached as to the internal heat of the earth? The earth appears to be solid and rigid, with a nucleus or centrosphere which consists chiefly of nickel-iron, of something like 3,000 miles radius. That nucleus is a good conductor of heat, and it is practically insulated by an envelope of igneous rocks, more than 800 miles thick, which is a much poorer conductor Under such conditions the heat of the nucleus must be uniformly distributed, and the temperature, from margin to center must be the same, and probably lower than the melting point of iron or 1,600° Centigrade (about 2,900 degrees, Fahrenheit). It is probably much lower

As for the rocky envelope, it is difficult to see how its temperature could be any higher The thermal equilibrium is probably complete From the center of the earth to the zone of isostasy, changes of temperature are probably very slight Above it, in the region of new heat, there are continued fluctuations

¶ *Dr Clarke, the noted geochemist who prepared the interesting article you have just read, has devoted many years to a study of meteorites In an early issue we hope to present his conclusions concerning the nature of these peculiar bodies*

Our Point of View

To Make Our Libraries Efficient

A GREAT library—and a small one for that matter—can never be thoroughly efficient, that is to say, its stores of information cannot be readily available to the public unless it is in the hands of an expert librarian and a well-trained staff. Many of our greatest libraries are suffering today from the lack of such a staff. The growth in the size of these institutions and in the number of readers has been such, that, in many cases, they have outstripped the ability of the library staff to render effective service. Very largely the present conditions are to be attributed to the low rate of pay in proportion to the responsibilities and work entailed, for it is notorious that, since the war, the pay of librarians has not been increased proportionally to that of workers in other professional lines.

A noble building, housing a vast library complete with every modern appliance, will miss the great object of its existence unless the stores of knowledge contained between the covers of its books are readily accessible to the public. Today, in too many of the libraries the delay in obtaining some special book is apt to be lengthy to the point of exasperation, and too often the applicant has to be turned away, because the desired work is buried in the ever-accumulating mass of books.

Because of the existing conditions, all who frequent our libraries will be rejoiced to learn that the Carnegie Corporation of New York has set aside four million dollars for library purposes—the sum to be payable over a ten-year period. One million will endow a graduate school of librarianship in some great university, another million will provide an annual income which will be used to aid other library schools; a third million is for general endowment of the American Library Association—the income to be used in promoting the extension and development of library service; the fourth million is for carrying on the general activities of this Association and in aiding library schools until the three million endowment, in cumulating capital grants, is completed. Under the administration of the American Library Association, this sum of four million dollars should go far—not merely in improving the personnel of our great libraries, but in developing intensively the small library service.

Arbor Day and Tree Planting

ARBOR DAY is the American counterpart of an ancient custom. History teaches us that it was the practice among the early peoples to plant sacred groves and memorial trees and lay out shaded academic walks and stately avenues. Arbor Day, however, is of purely American origin and grew out of the conditions peculiar to the great plains of the west which were practically treeless over a large part of their area. To Nebraska belongs the credit for the initiation of the Arbor Day movement, when at a meeting of the State Board of Agriculture of that state, a resolution was adopted to set apart Wednesday, the tenth day of April, 1872, as a day to be consecrated to tree-planting in the state of Nebraska, and to be known as Arbor Day.

The movement thus initiated proved to be healthy and lasting, but its widespread success and its continuity were assured when it was recognized how strongly this movement would appeal to the children of the country. As a school festival, the observance of Arbor Day has spread not only throughout the United States but far beyond its borders. It is now in vogue in all the dependencies of the United States and in Great Britain, Canada, Australia, South Africa, France, Norway, Russia, Japan and China. The time of the observance of Arbor Day varies in different states and countries and is determined somewhat by climatic conditions. In general, the date is early in the year in the south and is set in the late spring in the more northern states. Over half of the states have enacted a law for its observance, and in two of the states—Nebraska and Rhode Island, it has been made a public holiday.

But the work of the schools is only a part of the widespread efforts to repair the damage which has been done to our once magnificent and far-flung forests. One of the most encouraging signs for the future is the growing realization by the lumber interests of the importance of forest conservation. The National Lumber Manufacturers Association which is pressing the point of view of the forest industries recently gave $100,000 to the Yale School of Forestry. On the other hand, although these efforts are encouraging, we must remember that a vast amount of work has yet to be done before the people of the United States and their Government can claim that they have taken hold of this great problem on a scale proportionate to its magnitude.

Luther Burbank

In the death of Luther Burbank, the world has lost one of its greatest benefactors and the United States one of its most noted citizens. There is a bond of very real sentiment between an editor and his "earliest subscribers," and Mr. Burbank was one of these. In his last letter (February 24th), he wrote, "Sixty years ago I took the Scientific American," and he maintained his touch with us to the end. The article on another page of this issue must have been one of the last efforts of his amazingly active life.

Typically American is the life story of this son of a New England farmer, who, with no other capital than his keen intelligence and astonishing capacity for work, rose to be one of the world's most famous naturalists and without a rival in his own chosen field of controlled evolution. The work of this great experimentalist in the plant world remains as a lasting benefaction to the race. His improvement of the staple foods of mankind is his finest monument—a monument draped, as it will ever be, by the exquisite blooms that were the offspring of his rich fancy and unremitting care. The simple epitaph on Wren's tomb in St. Paul's Cathedral may well be applied to Luther Burbank: "If you are seeking my monument, look around."

Norman Keep or Gothic Cathedral

ONE of the biggest problems confronting the architect today is that of developing the style of architecture which is best suited to the exaggerated height of the modern office building. Those of us who have grown up with these structures and have found something intriguing in their architectural treatment, will remember the successive steps by which the tall building has developed from a rigid and monotonous structure to the noble designs of the present day.

The first tall buildings were frequently likened to a huge elongated packing case, on whose four sides the windows were arranged in a monotonous checkerboard fashion. In the first period of development, an effort was made to break up these ugly surfaces by running across them at intervals heavy bands of cornice-like moldings, only to discover that the building now looked like a series of packing cases imposed one upon another. Some twenty years ago, we stated that since the modern office building was in effect, if not by intention, a tower, it would be best to accept the situation by emphasising the vertical lines of the building. Shortly thereafter, several designs appeared which treated the building as though it were a Brobdingnagian classical column—a few of the lower stories being treated elaborately as a base, followed by a dozen stories of plain design, and surmounted by something answering to the capital of a column. Then came the Gothic influence, of which the Woolworth Building is of course the most notable, as it is the most successful example.

The final and most satisfactory tall building architecture is the result of accident—the accident consisting in the passing of a zoning law which required that the upper stories of tall buildings should recede in a succession of steps to permit sufficient light to fall on the streets below. No sooner had two or three of these buildings gone up than everybody, architect and layman alike, realized that here was a fine solution of the problem. Thus was born what we have called the Norman Keep style as against the Gothic style which it has supplanted.

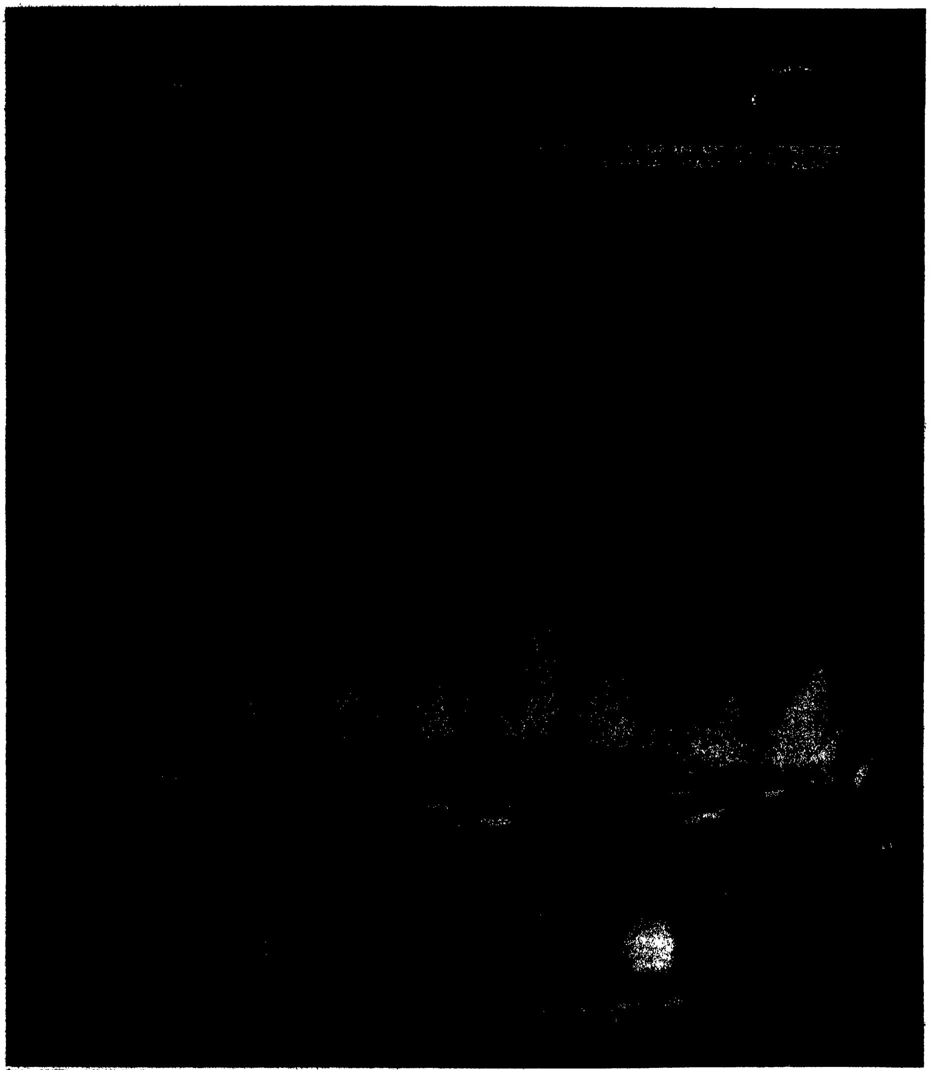
If you wish to realize the truth of this distinction, cross the Hudson River by ferry and look at the cathedral-like Woolworth Building and the medieval, Norman-type Telephone and Telegraph Building, and you will see at a glance that the palm for impressivness and beauty (we use the word advisedly) is carried off by the last-named structure.

Greatest Economic Factor in America

SURELY it is not stretching a point too far to say that the automobile is the greatest economical factor in modern American life. If you doubt it, we ask you to remember that the automobile bill of the American people is over 14 billion dollars a year—at least, so says a report by the Bureau of Industrial Technology; and they surely ought to know.

Our annual investment in automobiles is greater than the annual value of farm crops and over twice the annual investment in new buildings; hence, the automotive industry has risen to the position of the leading industry of the United States. This startling fact should not surprise us when we learn that the last annual registration of automobiles was about 20 millions; that the average automobile owner spends over $700 a year on his car; and that if each man, woman and child in the country were helping to pay the bill (and by the way, they are doing so indirectly) the annual expenditure per capita would be $117.

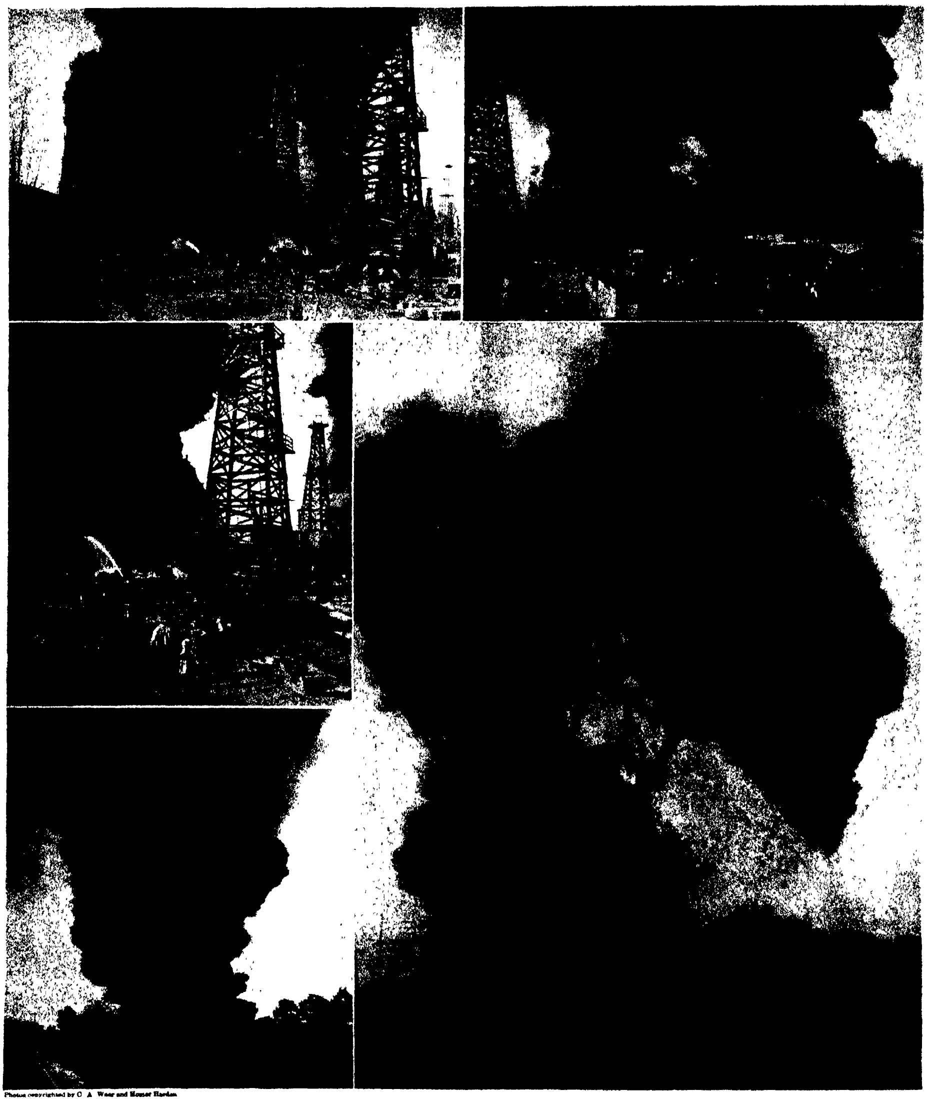
Not only is the industry stupendous in itself but its effects on other industries is in proportion. In road building, for example, where the programme now in the course of execution calls for the expenditure of about one billion dollars a year, and in the upbuilding of suburban communities where the new construction, in the case of many cities, is larger than that in the urban district itself.



Courtesy of the "Illustrated London News"

The Great Crimson Aurora of March 9, as Seen Over the City of London

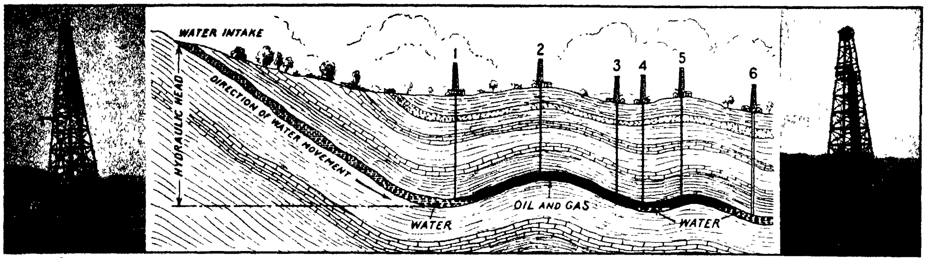
An auroral display of greater magnitude and beauty than any seen in fifty years was observed in England early last March. One observer states, that immediately after eight o'clock in the evening the pink coloration of the streamers became very strong, changing to dark but intensely luminous red. Auroras are caused when electrified particles shot from the sun strike the earth's upper atmosphere. Professor McLennan of Toronto University recently demonstrated that an aurora could be artificially produced by shooting cathode rays through an exhausted tube containing 25 parts of helium to one part of oxygen. Thus, we discover, indirectly, the composition of the upper atmosphere The height of an aurora varies from 40 to 600 miles.



Photos copyrighted by O. A. Weer and Homer Harden

Mileage Goes Up in Smoke

Oil losses in the United States are not as large as might be expected. In 1923 the loss from fire in derricks, refineries and pipe lines was $3,136,885, while in tanks or open pits it was $2,768,478. Not large compared with other risks. Two upper and middle pictures show oil field fire at Santa Fe Springs, California; damage $300,000. Large illustration shows a Texas well; fire caused by lightning. The lower left-hand picture shows an oil tank in flames.



LEFT: *An oil well 7,400 feet deep.* CENTER. *Oil-bearing sand. Well number 2 will get the most oil, number 6 will get none One of many non producing wells*

Uncle Sam, Spendthrift—II

Shall the "Wildcatter" Wreck Our Oil Resources as the Lumberman Has Wrecked Our Forests?

By J. Bernard Walker

IF Nature was generous in clothing the terrain of the United States with magnificent forests, she was even more lavish in providing vast resources of oil beneath its surface If the surveys of the geologists, so far as they have gone, can be relied upon, and we think they may, the oil fields of the United States, developed and undeveloped, are the richest in the world. We have squandered the rich patrimony of our forests until, after three centuries of occupancy of the land, only five-sixths of those forests are left to us. Are we following the same spendthrift policy in regard to our wealth of oil? There is grave reason to fear that we are.

To any one who dispassionately reads the story of the brief 66 years of life of the oil industry, it might look as though the slogan of the men concerned in it has been, "Grab, grab quickly, and grab all you can."

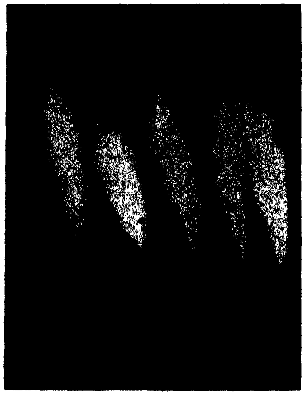
Be it known that this statement is not to be taken as an unqualified criticism of the oil industry The policy of getting the oil out of the ground as quickly as possible was rendered necessary by physical conditions over which the industry had no control. Unlike coal, oil is fluid; its recovery is on the principle of "first come, first served." The oil below one man's land may be drained by a neighbor's well. Hence the urge to grab quickly, and grab all you can.

Supply Is Not Inexhaustible

What has been the result of this policy? We read in a recent report of the American Petroleum Institute that "each decade since the beginning of the oil industry in 1859 has seen a volume of production equal to the total production throughout the whole previous history of the industry. During the years 1916 to 1925, more oil has been produced in the United States than during the whole previous period from 1859 to 1916." That is to say, we have taken out of our oil resources in nine years more oil than we did in the whole 57 years preceding. This being the case, the advocates of conservation will naturally ask themselves, how long will it take to bring our oil resources to the same lamentable state of depletion as our forests? We frankly admit, after a rather lengthy investigation of the subject, that this is a question more easy to ask than to answer.

We regard it as unfortunate that many of the able leaders in the oil industry (see the report of the Petroleum Institute) seem to think that Nature has stored oil in such unbelievable abundance that it simply can never be exhausted. On the other hand, the hearings before the President's Conservation Board proved that there are men of foresight and broad vision, possessed with a deep concern for the country's future, who not only believe that there is a measurable limit to the amount of oil in the ground, but believe also that only optimism gone mad would dare to assert that new methods of getting the oil out of the ground and more economical refining and use of it above ground, will so increase production and reduce consumption that the oil business, like Tennyson's brook, will merrily "go on forever"

What is "oil," or petroleum as it is known in the industry? In the first place, let it be understood that although it is called a mineral, it is actually organic or of animal and vegetable origin. There is today a general consensus of opinion that petroleum is derived directly from the animal and vegetable life of remote geological ages. This theory, which we believe to be the correct one, is based upon the fact that petroleum is found in certain underground layers of sands, sandstones, shales, and limestones. The "sands" as they are called, are believed to have been deposited under water, in remote ages, at the bottom of inland lakes, marshes and the sea.



WHOLESALE WASTE OF GAS

Formerly gas was considered a nuisance and burnt at the well. Today it is conserved and yields ten percent of the total gasoline supply

As the deposits were formed, they included within them the dead bodies of the smaller marine animals such as fish, oysters, mollusks, et cetera, and enormous quantities of the tiny microscopic organisms known as foraminifera It is also believed that decayed vegetable life was included with the animal remains, for in some of the oils is to be found a *certain amount, and in some cases, a large amount* of the material of seaweed and land plants It is believed that heat, pressure, et cetera, acting upon the organic matter of these deposits, formed in the course of ages certain hydrocarbon products which are known to the world as petroleum These oil sands exist in several separate layers, and they vary in depth below the surface from a few hundred to several thousand feet Immediately above and below the sands are found impervious layers of shale, sandstone, or limestone, which serve effectually to shut in the gas, oil and water contained in the sands, thereby transforming the latter into vast, more-or-less horizontal, gas-tight reservoirs.

How "Pools" Were Formed

In the course of ages, what was once sea bottom became dry land As the land was lifted and the enormous pressures due to the slow contraction of the earth's crust under cooling were developed, the oil sands and the adjacent strata lost their horizontal position and were "folded" into what are known as anticlines and synclines, or gently sloping hills and valleys It was the folding of the strata and the action of gravity that caused the oil to gather mainly in the upper arches or domes and form the rich "pools" which have proven such prolific reservoirs of oil

Just here, let it be understood that when we speak of an oil pool, it must not be supposed that the oil is found in great underground lakes Far from it. As a matter of fact, the hydrocarbons resulting from the decomposition of vegetable and animal matter are found to be rather evenly distributed throughout the enclosing sand or rock They are locked in the microscopically small voids between the grains of sand, and are invisible to the naked eye At the office of the Geological Survey, they will show you a core of sandstone which is very rich in

TYPICAL EARTHEN OIL RESERVOIR

When the rush of oil is greater than tanks and pipe lines can carry, it is held temporarily in depressions of the ground. There is loss by seepage and evaporation

oil. To your eye, it is just a piece of buff-colored sandstone, apparently as dry as a bone. Now, the oil sands are under heavy pressure, due mainly to the gas which is condensed within the oil, and also to the heavy hydraulic pressure of water which has entered where the sands outcrop at the surface. The gas, oil and water arrange themselves according to their specific gravities, and in the case of an anticline, such as the famous Teapot Dome, the free gas will be found at the top, followed by the oil and the water.

The pressures in oil-bearing sands are enormous, far exceeding the steam pressure in the average boiler; for in some sands they run up to as high as 1,500 pounds or more to the square inch. When the drill with its enclosing tube or casing drives through into the sands, the age-long conditions of equilibrium are upset. The well forms a vent, and immediately the gas pressure begins to drive the oil out of its myriads of tiny pockets and force it towards the well opening. If there is a pocket of free gas, that is the first material to rush up to the head of the well, and after that comes the mass of oil which, in the case of the great gushers, will go roaring up in a vast column as high as 300 or 400 feet.

As the oil in the mass of sands immediately surrounding the well is driven out, the oil from the more distant sections of the stratum will be forced—squeezed, as it were—out of the sands, and, because of decreasing gas pressure, it will travel more slowly and in less volume. A time will come when gas and hydraulic pressures are insufficient to carry the oil in any volume up to the surface. Recourse must then be had to pumping, which will be continued until the cost of raising the diminished amount of oil is too great to render further operation of the well profitable, when it is abandoned.

In the early days of the oil industry, there was an enormous waste of gas and oil due to their arrival at the surface before adequate provision had been made to receive them. That was the time when, in his eagerness to get at the oil, the miner was wont to look upon gas as something of a nuisance. If there was a town within convenient reach, it would be piped and used for power and illuminating purposes. If not, it was allowed to escape (millions of cubic feet of it) into the air, and frequently, in order to get rid of the odor, it was led away to a pipe or a row of pipes known as "flambeaux," where this valuable product burned away day and night.

Production Losses Diminishing

If indifference, or lack of knowledge and skill, was shown in this deplorable waste of gas, there was also in the early days of oil recovery, and indeed in rather recent times, a great loss of the oil itself, due to the failure to provide for its arrival at the surface. Where a well suddenly began to pour forth oil at the rate of 15,000 to 30,000 barrels per day, the rush would be so terrific as to completely overwhelm the driller and his assistants. In some of the great Mexican gushers, the oil would tear loose the pumping plant and go rushing up through the timber derrick, ripping it to pieces, and flooding the countryside with oil. Sometimes the gusher could be controlled; but in other cases, the oil would continue to escape until the first great rush was over. In hundreds of wells, where no provision had been made for surface storage, the oil would be allowed to flow into some depression, where a dam would hold it temporarily. Here again the waste would be deplorable, for there would be loss by seepage and the richer constituents of the oil would evaporate.

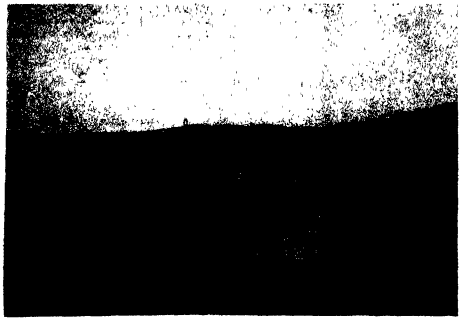
Now, although waste of gas and oil in the early decades of the oil industry was, as we have shown, enormous, and even today is not fully controlled, it must be borne in mind that the experts of the industry are bending every effort toward reducing these production losses. Before the drill enters the oil-bearing sands, in all up-to-date and well regulated oil companies provision is made for turning the gas and oil into tanks and pipe lines, where it can be properly conserved. As a matter of fact, there is comparatively little waste between the well-head and the fuel tank of the steamer, the tender of the locomotive, and the gasoline tank of your own motor car. This loss, including the sojourn of the oil in the storage tanks, its thousand-mile journey in the pipe line, its manipulation in the refinery, and its transportation by tank car and truck to the filling stations, is estimated to be not over 3.5 percent.

THE GREAT LAKEVIEW GUSHER

The oil rushes forth under enormous pressure. The production of this well was 55,000 barrels a day. A few days later the derrick was completely demolished

The largest waste in the oil industry today is underground. For every barrel of oil brought to the surface, three barrels of oil are left in the sands. And that one barrel of oil which we bring to the surface is being most wastefully consumed in the motor car, which, so the experts tell us, burns twice as much gasoline for a given mileage as would be required if carburetors and motors were redesigned with a view to economical operation. Finally, there is the enormous waste of capital involved in the unintelligent drilling every year of hundreds of "wildcat" wells that never bring up a drop of oil.

¶ *In our August issue, Chapter III of this series will deal with the present output and consumption of oil and the proposed methods of conservation.*

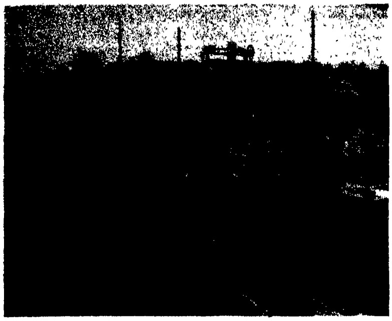


A MAN-MADE FOREST

Wharves and oil wells on the beach in front of Summerland, California

ONE OF THE EARLIEST WELLS

This oil well was drilled as far back as 1864; and it is still producing



HOW THE CONCRETE SLABS ARE MADE

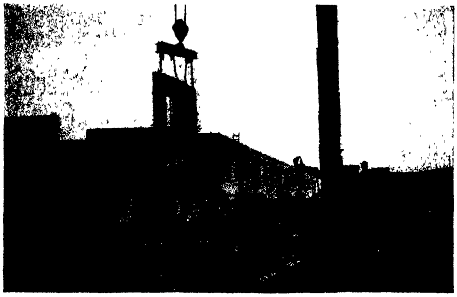
From the mixer the concrete is poured into simple forms which consist of edge boards, enclosing a space the height of one story, laid on level ground. The rough under side of the slab thus formed is ideal for plastering

Houses Built in Twenty-four Hours!

From prehistoric times, man has aspired to possess his own home. This instinctive desire finds its fulfillment—now that labor and materials have advanced so substantially in cost—for but comparatively few fortunate enough to have a surplus over living expenses. The vast majority must rent. With these rising costs, the rent problem which is presented to the average family narrows down to a question of just the minimum space necessary for existence, in order that the total budget may also include certain items for relaxation or enjoyment which are now considered essential. Much is being advocated by influential individuals; some small amount is being accomplished by organizations with capital. Apparently the solution lies in the fact that only in large undertakings can costs be reduced, so that rentals will be proportionally cheapened, while at the same time more adequate living space is provided. The accompanying illustrations of a project in the suburbs of Berlin show what is being accomplished there in the mechanical construction of community housing. After the concrete slabs are set by the slow but efficient process of drying from one side, the shell of the house can be placed in twenty-four hours. The joiner work, plastering and trim proceed as in other construction. Machinery, cheap labor and cheap, easily obtainable materials are the outstanding features. Further developments along this line are sure to follow the intensive study of the reduction of building costs.

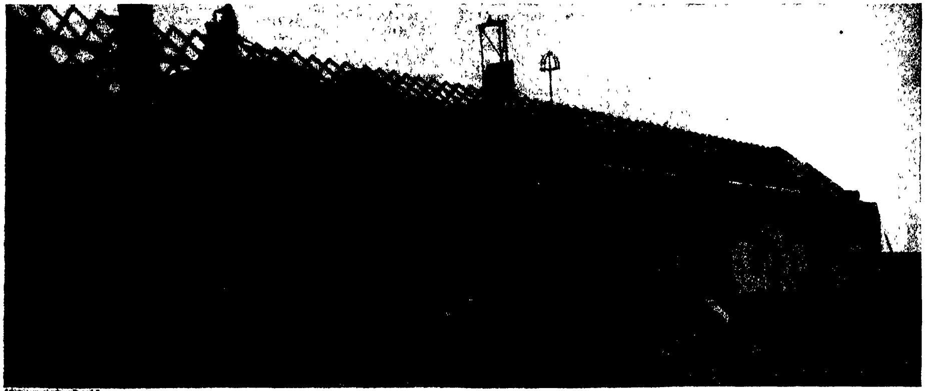
MECHANICAL AIDS ARE USED

This photograph shows a large gantry crane which "straddles" the row of houses, reaching all parts of the buildings and quickly placing material where it is needed



LOWERING THE COMPLETE SECTIONS

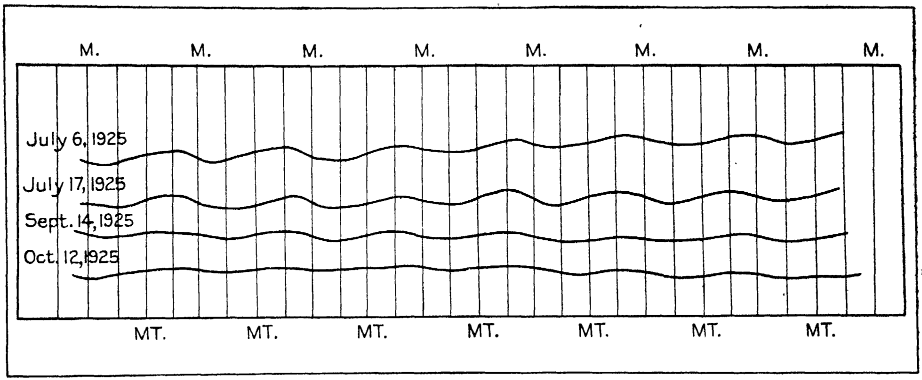
The one-story sections are lowered into place and the recessed ends, flushed with cement are fitted into each other. Three men only are needed for this operation



All photographs from P. and A.

FINISHING IS DONE BY SKILLED LABOR

An auxiliary conveyor supplies the materials for the interior finish of each house in rotation. The main structure is built by cheap labor and handled by machinery, thus minimizing the labor cost. It is so economically produced that the relatively small amount of skilled labor necessary for finishing does not materially increase the total cost



SUCTION FROM THE LEAVES OF A YOUNG WALNUT SHRINKS THE SAP-CARRYING WOOD, REDUCING THE DIAMETER OF THE TREE, ON WARM DAYS

FIGURE 1 *Each wavy line shows the daily variation in diameter for a given week (note dates) The downward course of the curves as they cross the respective noon lines (M,M) denotes shrinkage during most of the day, while the upward course at midnight (MT, MT) denotes expansion at night The greatest actual growth and daily variation occurred in the week of July 6. No growth and but little variation in October This and the other diagrams were adapted from Publication 373, of the Carnegie Institution of Washington, D. C. (1926)*

The Hydrostatic System of Trees

The Force that Draws Tons of Sap to the Topmost Branches of Trees Is the Evaporation of Water from the Leaves

By Dr. D. T. MacDougal

Director, Laboratory for Plant Physiology, Carnegie Institution of Washington

TREES maintain sun-driven factories in the leaves for making sugar and other organic substances. Water taken in by the roots is lifted ten, a hundred or two hundred feet to the leaf-mills. Then the liquid products are conveyed downward to all the living cell-masses and out to the extreme tips of the roots, which in tall trees may be three or even four hundred feet from the leaves

In view of these facts it is not surprising to learn that a distinct hydrostatic system is to be recognized—a hydrostatic system which is not essentially different from that in small plants, except that in trees its working parts are so large that they are readily discernible.

The Leaves Are the Real Pumps

Before proceeding to a discussion of this mechanism we may well rid ourselves of any mistaken idea as to the existence of a "circulation" in a plant, or that the plant has a "heart" or that it shows pulsations. Such imaginative conceptions are wide of the facts and are artistically and sentimentally false and barren.

On a summer day a large tree pulls thousands of liters of water up through the trunk. Of this amount all but a small fraction evaporates and in so doing it furnishes the lifting power which is responsible for the ascent of the sap. The small remainder, perhaps a few liters out of every thousand that reach the leaves, goes into chemical combinations with substances such as the sugars. It makes a solution of these and other organic substances produced in the leaves and then it starts back on the slow downward journey, which has its terminus in the roots.

Why a Tree Is Not a Standpipe

Have you ever wondered how trees raise their many tons of sap so far aloft? Consider a tree, 100 feet in height, and beside it place a vertical, hollow standpipe of the same dimensions. How could the pipe be filled with water? A suction pump would fill it only to 30 feet. A force pump would fill it to the top, with a resulting pressure of 43 pounds per square inch at the bottom.

But the tree is not like the standpipe, nor has it a mechanical pump. The popular comparison with the standpipe falls down in the case of the tree because the tree draws its sap through thousands of minute pores—tiny tubelets so small that capillary attraction is effective in them. It is the combination of this capillary attraction or surface tension, with the tremendous force exerted in the leaves when the sap that is already in them evaporates, that acts to raise the sap hundreds of feet above the ground.

To illustrate the hydrostatic system of the type prevalent in large, woody plants, a fast-growing pine or walnut may be chosen. These trees form a layer of wood in every favorable year. When the trunk is cut across, this layer appears as an annual ring. The leaves which arise this spring are inserted on or connect with the thin, woody cylinder of the previous year. In the case of evergreen trees, in which the leaves endure a second or third season, leaves connected with two, three or even four layers may be present. This is true, for example, in the case of the pines

The ascent of the sap always takes place along the conduits of the older wood, with which the leaf-pumps are connected. These water-carrying layers and the living cells external to them, composing the cambium which is found between the bark and the wood, form a complete gas-tight cylinder enclosing the older wood which is filled with air. (Figure 3). The air body in the central wood differs in composition from the atmosphere, and varies with the season. In the autumnal condition the proportion of carbon dioxide in the air of a walnut trunk may be sixty times as great as that of the atmosphere.

The tree-trunk is therefore a hollow cylinder of water extending without break to the surfaces of the water-filled living cells of the leaves above, and down through the roots into the soil, enclosing a central air or gas chamber. The expansion and contraction of this gas body follows changes in temperature and the action of the sap-lifting pumps.

4,400 Pounds Per Square Inch!

The living cells in the leaf, which are the seat of the forces which lift the sap, are distended masses of living matter enclosing vacuoles or cavities containing water in which sugars, acids and salts are dissolved. A cellulose wall surrounds the whole and the water of the protoplasm extends through the ultra-microscopic pores of the wall, ending at the outer surface in minute menisci or curved surfaces such as may be seen when a capillary glass tube is placed upright in a dish of water.

In the latter example the water in the capillary tube will rise to a height determined by the diameter of the tube and surface tension of the water. Similarly the water in the minute tubular pores in the cellulose walls of the leaf cells comes to the surface and spreads into the thinnest of films at the margins. These pores are so numerous and so crowded that a continuous film covers the entire surface of the wall.

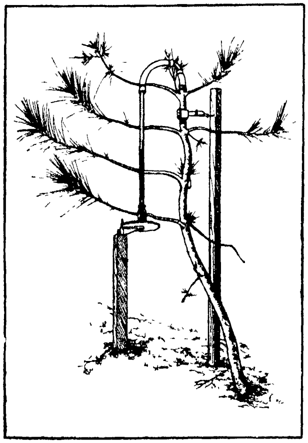
When particles of water are lost from these surfaces by evaporation, water is pulled through the pores in replacement. The water in the pores is continuous with that in the living cells, and this in turn is continuous with the columns in the cavities of the vessels and wood, so that the pull extends to the roots and even to the water in the soil.

The force which may be exerted in this manner may be as great as 200 to 300 atmospheres (2,900 to 4,400 pounds), and thus the sap may be carried upward at a rate of one to three meters per hour The resistance encountered rises with the speed of the pump. In consequence of the great power exerted by the leaf-pumps, the suction is so great on a warm summer day that the sap-carrying wood is caused to shrink. This is well illustrated by the graphs in Figure 1, which show the varying diameter of a walnut tree at different times. It will be noted that the variation is much less in October when most of the leaves have fallen off.

Immense Force of Surface Tension

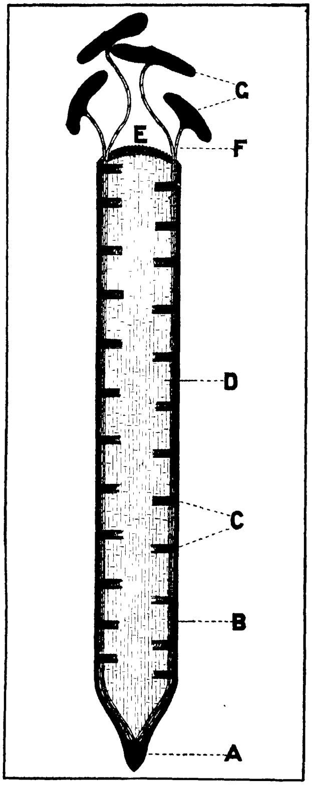
The action described takes place in conduits with bores so minute that the attraction of gravity is far overbalanced by surface tension. If gravity affected the rise of sap, the liquid in a trunk should all run out when it is cut across. Likewise, if gravity dominated the process, the water could not be expected to rise above about 30 feet (like that in a suction pump), or to the equivalent in weight of the barometric column.

The conception of the cohesiveness of a column of water, which is so great that it will hang together like a rope, is not one which can be illustrated by obvious facts in common experience, yet it may be readily demonstrated in the laboratory. In this test a clean glass tube of small bore is fitted tightly with a clay cylinder such as those used in water filters or with an evaporimeter of similar material. The tube and the clay cylinder having been filled with water, the open end of the tube is stepped in a dish of mercury. Water evaporates from the menisci of the clay surfaces, to be replaced by water from within. Thus mercury is pulled up from below This action may continue until a column of mercury much higher than the barometer is drawn up into the tube, even though the latter has a bore thousands of times as great as the cavities of the conduits of trees. If it were possible to make and manipulate glass tubes in this apparatus as small as the wood conduits, a mercury column could doubtless be lifted many meters high.



DEMONSTRATING TREE-TOP SUCTION

FIGURE 2: *A glass tube immersed in mercury is connected to the upper end of a pine tree by rubber tubing. Here, suction has pulled up the mercury seven inches*



THE SAP SYSTEM OF A TREE

FIGURE 3 *The heavy, outside shading denotes the layer of living cells on the outside of the wood. This layer terminates in the roots, A, the buds, E, and the leaves, G Layer B is recently formed wood. The leaves are shown inserted on the second and third layers, as in a pine tree D is old wood, containing gases. C, C, are rays including living cells*

It is not to be supposed, however, that the plant physiologist has cleared up all of the features of the movement of sap in plants. He is not so sure, for example, as to what takes place at the foot of the water column in the roots as he is as to the action in the leaves. The pull from the leaf-pumps may extend not only to the extreme surfaces of the roots but out into the soil, and doubtless does so in some plants. In many plants, however, an osmotic action takes place in the roots. This pulls water in from the soil, and forces it upward in the wood so that if the stem be cut off it will exude from the stump. This action is notable in grape vines, palm stems, birch trees and in many other common species. This "root-pressure," as it is called, is invariably complicated; the "bleeding" of a pruned vine or shrub is partly due to other agencies.

The suction and sap pressures in plants have engaged the attention of experimentalists since the time of Nehemiah Grew (1682).

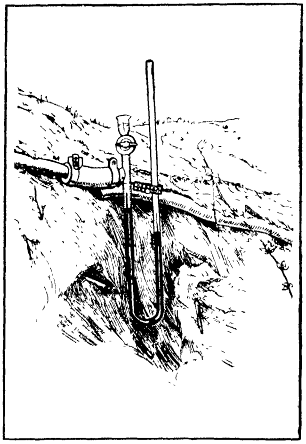
Gages attached to the bases and stumps of trees have shown apparently discordant results, in the hands of scores of workers The identification of the hydrostatic system as described above has made possible the interpretation of pressures in various parts of the root, trunk or branches.

Thus, if a manometer is attached to a bore in the outer wood of a walnut tree a suction will be shown in the midday period when the leaf-pumps are in action pulling upon the water column. Simultaneously, another gage driven in to connect with the gas-filled wood of the center of 'the trunk may show a positive pressure. This is due to the temperature expansion of the gases

How Roots Suck Water

Again it is notable that a gage attached to the cut stem of a pine tree (Figure 2) shows nothing but suction, anything like "root-pressure" being lacking, and the expansion of the gas in the central core acts to diminish suction but never to give positive pressure. Similarly a gage attached to the terminus of a cut root of pine (Figure 4) will always show suction, although positive pressure is sometimes measured by a gage attached to the root of a walnut tree. The hydrostatic system of the conifers differs in many important features from those of the dicotyledones.

The features of the hydrostatic system as delineated above furnish an adequate mechanism for carrying water or sap upward in trees The path by which the indispensable products of leaf-activity are carried downward to all the living cells lies in the external part of this system but it has not been definitely localized This and the nature of the forces involved remain as unsolved problems to the plant physiologist.



LEAF SUCTION FELT AT THE ROOTS

FIGURE 4 *A U tube filled with mercury is connected with the cut end of a pine root Suction originating in the leaves has pulled the mercury up to a height of three inches*

The Applied Science of Public Spending

Through an Effective Budget System Our Government Is Saving Millions This Year

By Albert A. Hopkins

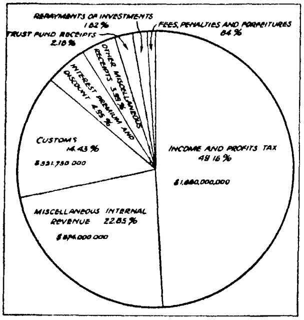
YOU cannot eat your cake and have it, too, is an old saying which embodies more truth than poetry. Yet that is the very thing the Government of the United States is now trying to do—cutting its income, cutting its expenses and still having more to show for its money.

And how is it accomplishing this anomaly?

By a scientific budget system.

President Coolidge explained the principle of it on January 30, last, over the radio.

"Merely to reduce the expenses of the Government might not in itself be beneficial," he said. "Such action might be only the discontinuance of a wholly necessary activity. No civilized community would close its schools, abolish its courts, disband its police force, or discontinue its fire department. Such action could not be counted as gain, but as irreparable loss. The underlying spirit of economy is to secure better education, wider administration of justice, more public order, and greater security from conflagration, all through a superior organization which will decrease the unit of cost. It is all reducible to a question of national efficiency."



ESTIMATED RECEIPTS FOR 1927

The estimated government receipts by sources of revenue (excluding the Post Office Department) for the fiscal year ending June 30, 1927, may be $3,824,530,203

In the good old days when government was deliciously simple all the sultan or the maharajah had to do when he wanted more money was to raise taxes. It was the more or less loyal taxpayers in those days who originated the slogan, "Give till it hurts."

Lately, the men who have been applying science to the administration of public affairs have been working on a different theory. Instead of adopting "all the traffic will bear" as their motto, they figure that increasing the traffic will produce still better results.

"Past experience has shown that a reduction of taxes has been followed by increased prosperity," Mr. Coolidge explained. "As the volume of business increases, the Federal revenue increases

"If we are moderate in our expenditures, the natural increase in profits ought within the next few years to furnish us again with a surplus revenue which will permit a further tax reduction. We were the first nation in recent years to adopt a plan to reduce our debt and put the plan into operation. We are maintaining our sinking fund and applying the payments made on our foreign loans to the retirement of our debt.

"As a result, this nation has today the best credit in the world. We have lowered our interest costs not only by reducing our debt, but by so improving our credit that we can borrow at lower rates. Since interest is 22½ percent of our total Federal expenditures, a reduction in interest is a more fruitful field for permanent saving. If we continued this plan during the post-war depression, there is certainly little reason for changing it in these days of prosperity."

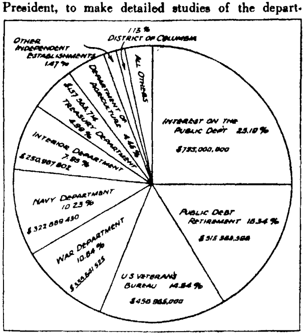
All of which sounds like good common sense. But how can it be accomplished? That is the job for which General Herbert M. Lord, Director of the Budget, is responsible.

Functions of the Bureau of the Budget

"The Bureau of the Budget was created by the act approved June 10, 1921," says he. "It is in the Treasury Department but not under the jurisdiction or direction of that department. The Bureau is under the immediate direction of the President. Under rules and regulations prescribed by the President, the Bureau prepares for him the annual budget and such supplemental or deficiency estimates as the President may recommend from time to time to Congress. To this end, the Bureau has the authority, under the act, 'to assemble, correlate, revise, reduce, or increase the estimates of the several departments and establishments.'

"The act requires the head of each department and establishment to appoint a budget officer whose duty it is to prepare, under his direction, the departmental estimates of appropriations and such supplemental or deficiency estimates as may be required. These officials are liaison officers between the department and the Bureau of the Budget. The estimates are prepared and submitted to the Bureau in such form, manner and detail as the President prescribes. On or before September 15 of each year, the head of each department and establishment revises his estimates and submits them to the Bureau.

"The Bureau is authorized, when directed by the President, to make detailed studies of the departments and establishments for the purpose of enabling the President to determine what changes should be made, in the interest of economy and efficiency, in (1) the existing organization of activities, and methods of business of such departments or establishments, (2) the appropriations therefor, (3) the assignment of particular activities to particular services, or (4) the regrouping of services.

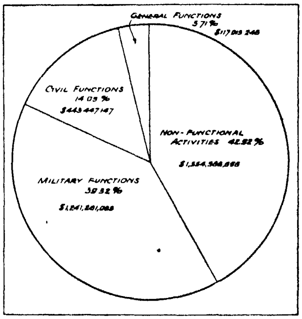


ALLOCATION OF THE AVERAGE DOLLAR

The United States Government will appropriate for the fiscal year ending June 30, 1927, $3,156,130,358. There is a difference between "Estimated Appropriations" and "Estimated Expenses." The latter figure is $3,494,222,308

"Each department and establishment is required, under regulations by the President, to furnish to the Bureau such information as the Bureau may from time to time require. Officials of the Bureau are given the authority to have access, for the purposes of examination, to the books, papers and records of any department or establishment."

Does that plan work out in practice? Apparently. Last year the Government's total receipts, not including the postal revenues, were $3,780,148,684.42. The total expenses, also leaving out the postal items, were $3,509,643,446.09. The excess of receipts over expenditures, therefore, was $250,505,238.33—not a bad net profit for a big business establishment.



WHERE THE APPROPRIATION WILL GO

The Post Office Department is not included. The amounts for the fiscal year ending June 30, 1927, will be $3,156,130,-358. Note the size of "Military Functions"

What is happening this year is, of course, more or less a matter of conjecture. The figures that have been set down, however, have been verified so well by past experience that we may consider them as substantially accurate. The annexed tables showing the estimated receipts and expenditures for 1926 indicate that our excess will be about $262,041,756.

ESTIMATED RECEIPTS FOR 1926

Income Tax		$1,880,000,000
Miscellaneous (Internal Revenue)		864,000,000
Customs		556,750,000
Foreign Obligations:		
Principal	$ 31,257,243	
Interest	163,377,046	
	$194,634,289	$194,634,289
Miscellaneous Sources		139,701,343
Securities		123,869,853
Trust Funds		75,961,827
Proceeds from Surplus Property		24,799,630
Panama Canal Tolls, etc.		21,000,000
		$3,880,716,942

Estimated Expenditures for 1926

Interest on the Public Debt.	$820,000,000
Public Debt. Retirements Chargeable against ordinary receipts	500,428,595
U. S. Veterans' Bureau	388,515,000
War Department	347,289,031
Navy Department	342,305,000
Interior Department	293,867,508
Refunds of Receipts	186,247,500
Operations in Special Accounts, Shipping Board, War Finance Corporation, Alien Property Funds, etc.	183,899,047
Department of Agriculture	162,901,222
Treasury Department	132,237,928
Investment of Trust Funds	49,542,050
Postal Deficiency	37,067,449
District of Columbia	36,516,448
Other independent Offices and Commissions	32,179,331
Department of Commerce	29,427,640
Department of Justice	25,053,160
State Department	16,135,032
Legislative Establishment	16,011,245
Panama Canal	10,213,394
Department of Labor	8,355,599
Executive Proper	483,007
	$3,618,675,186

The figures above are for the calendar year. The estimates for the fiscal year ending June 30, 1927, were submitted to Congress last December. The receipts are estimated at $3,824,530,203 and the expenditures at $3,494,222,308.44, making the surplus $330,307,894.56.

The best laid schemes o' mice and men and budgets gang aft agley, however, and no matter how carefully estimates are made, some unforeseen leak is more likely than not to drain off the savings of efficiency and economy.

Notwithstanding all the bad luck which tends to wipe out a hoped for surplus, however, the Bureau of the Budget succeeded last year in really reducing expenses $60,000,000 or $166,666.67 for every day; $6,944.44 every hour. One of the plans used to bring this about was a "Two Percent Club," the various bureaus engaging to reduce their programmes two percent.

Government Sets Example of Thrift

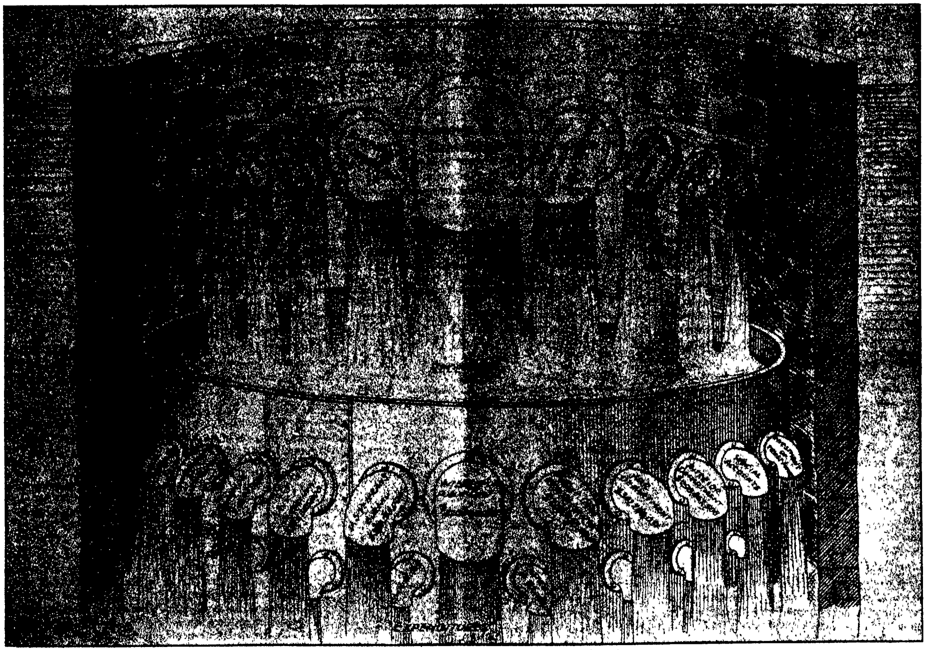
"I was notified by telegraph that the Navy had joined the club with a guaranteed reduction of $6,600,000 in its estimated expenditures with hope of a further reduction of $2,000,000," says General Lord. "It was an inspiring beginning. Throughout the length and breadth of this country was broadcast the Navy's gallant response to this call to arms in the interest of reduced spending and lower taxes. But, when the smoke of the battle cleared away, the Navy was found in the list of casualties, with an expenditure of $14,000,000 in excess of its original estimate, rather than $6,600,000 less—a change amounting to $20,600,000.

"The Army promised nothing, and kept its promise by spending $17,000,000 more than it estimated. But the Army got no advertising out of it except what it is getting now." The Director then goes on and gives the names of the departments and bureaus that made the grade and proposed a 'One Percent Club' to lop off at least one percent of the estimated expenditures

"The Federal Government in reducing its expenditure, cutting its taxes, and lowering its debt," he continues, "is setting an example of thrift to other taxing agencies in this country which should help materially to reduce the cost of living so that the child's faith in and respect for the penny may be renewed, the quarter may again become a respectable member of financial society, and the dollar again lift its head in the marts of trade."

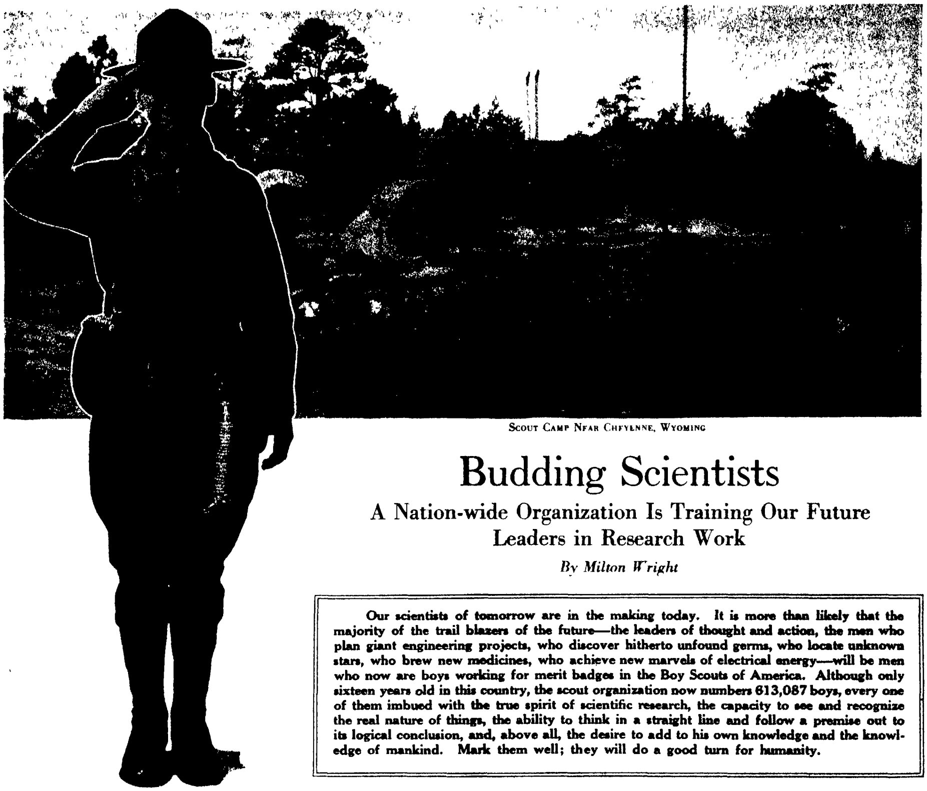
The Government payroll on December 31, 1925, carried 114,696 fewer employees than it carried on December 31, 1920, making a yearly saving of $138,000,000. The reduction excludes the postal service, which is a constantly growing activity requiring more and more workers every year. Of the officials who have cooperated with the Bureau of the Budget to bring this to pass, General Lord says:

"We wonder how we managed so many years without them. They have been helpful in so many ways, have straightened out so many tangles, have contributed so materially to good fellowship in the service, have so worn down the old barriers that separated departments from departments and bureaus from bureaus, that they stand today the acknowledged apostles of teamwork and efficiency, which march hand in hand."



HOW UNCLE SAM IS MANAGING HIS AFFAIRS IN 1926

Estimated receipts, $3,880,716,942 for 1926; estimated expenses, $3,618,675,186 for 1926. Our comparative illustration shows the estimated receipts and estimated expenditures for the year 1926 based on Treasury estimates It should be remembered that the Postal Establishment is not considered except when there is a postal deficiency



Scout Camp Near Cheyenne, Wyoming

Budding Scientists

A Nation-wide Organization Is Training Our Future Leaders in Research Work

By Milton Wright

Our scientists of tomorrow are in the making today. It is more than likely that the majority of the trail blazers of the future—the leaders of thought and action, the men who plan giant engineering projects, who discover hitherto unfound germs, who locate unknown stars, who brew new medicines, who achieve new marvels of electrical energy—will be men who now are boys working for merit badges in the Boy Scouts of America. Although only sixteen years old in this country, the scout organization now numbers 613,087 boys, every one of them imbued with the true spirit of scientific research, the capacity to see and recognize the real nature of things, the ability to think in a straight line and follow a premise out to its logical conclusion, and, above all, the desire to add to his own knowledge and the knowledge of mankind. Mark them well; they will do a good turn for humanity.

SURROUNDING the little cemetery at Oyster Bay, Long Island, where Theodore Roosevelt lies buried, is a bird sanctuary given to the Audubon Society by the sons of the former President. In this sanctuary, near Roosevelt's grave, stands a grove of beautiful black walnut trees.

America has never known a better tree than the black walnut. From no tree in all the world has ever dropped a sweeter nut. And yet, this is the very tree that has suffered most in the ruthless cutting down of our forests

Through that grove every year boy scouts make a pilgrimage to do homage to their former leader. Last year they stopped and gathered up every walnut that had fallen. They sent them to scout troops in other places. The other scouts planted them as memorial trees. From all parts of the United States came requests for nuts for planting purposes. The pilgrim scouts will repeat the distribution this year, and the next and the next. It will not be long before thousands of walnut trees planted by boy scouts will be adding value and beauty to all our countryside.

Such an enterprise is practical conservation Many a scientist toiling for a lifetime will accomplish less for his fellows. It is only one small example, however, of the things boy scouts are doing to make the world a better place to live in.

It is generally agreed that the Boy Scouts of America is one of the greatest factors we have in making raw boys into useful citizens. Some of us believe the surest guarantee of future safety lies in a strong, broad boy scout organization. And when we come to study it we find that the biggest thing about the boy scouts is that it is a vast training school for scientists.

Scout Must Work to Win

The true scientist is a man who has learned two things: to see and recognize the true nature—the reality—of the thing he is studying, and to think in a straight line. These two things, above all, the boy scout learns. Stain a piece of wood and call it mahogany, if you will, but the scout knows it for pine; put two and two together in any line of thought and he knows they make four.

Even in a narrower sense the boy scout is a scientist, or at least a student of science. To advance in scoutdom a boy works to win the much coveted merit badges. There are seventy-one of these badges and thirty-four of them are for proficiency in subjects which fall well within the domain of science. Among these are agriculture, astronomy, aviation, botany, chemistry, conservation, electricity, insect life, mining, photography, radio and surveying.

All over the United States thousands of scouts are taking tests in these and kindred subjects. Lest you think such tests are merely superficial, glance for a moment at some of them. To obtain a merit badge for bird study, for example, a scout must:

1. Produce a list of forty species of wild birds which have been personally observed, and positively identified in the field.
2. Produce a list showing the greatest number of species that he has seen in the field in one week.
3. Produce a list, derived from personal observation, of twenty species of birds particularly noted for their value to agriculture in the destruction of insects.
4. Produce a list, derived from personal reading, of ten birds of prey particularly useful in the destruction of rats and mice.
5. Name ten species of birds particularly useful in protecting the trunks of trees from borers, bark-lice and scale insects.

6. Describe at least two bird boxes and two food tables that have been erected by him, the species of birds that have been attracted by them, and how many of the birds have nested in these boxes.
7. State what he has done to protect birds from wicked and unjust slaughter; to promote long, closed seasons for vanishing species; and to promote the creation of bird preserves and sanctuaries.

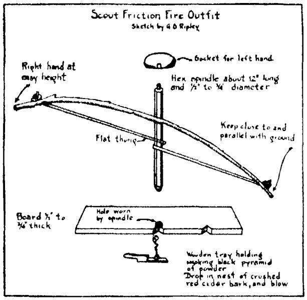
Or take botany. Could you meet this simple test that a boy scout must pass in order to obtain a merit badge:

1. Produce specimens of 50 species of 5 flowering plants without the roots (and in addition, where possible, 5 ferns) collected and named by himself.
2. Be able to identify 10 plants by their seeds. Produce specimens of the seeds.
3. Give a list of at least 5 plants that are usually found growing together in woodlands, or 5 near water; and 5 found in open fields, or 5 along roadsides. Produce specimens.
4. Tell the parts of a complete flower. Submit drawings.
5. Tell in a general way how plants manufacture their food.
6. Explain how ferns differ from flowering plants; and tell how they are reproduced.
7. Submit specimens collected by himself (with names if known) of 5 Fungi, 5 Algae or 5 Lichens; 5 Mosses or 5 Liverworts; or if specializing in any one of the above classes, submit 10 different species of that class.
8. Name 5 kinds of edible wild fruits; 5 plants used medicinally and tell what used for; 3 wild plants that can be cooked as "greens," and 2 edible "roots."
9. Submit an essay of at least 200 words on the "Conservation of Wild Flowers," naming at least 4 in danger of extinction.

Eliminating Square Pegs in Round Holes

All too often men's lives are wasted because they never found themselves. There are potential metallurgists of distinction who are teaching country schools, men who might have become great geologists instead of mediocre bookkeepers. They never got started on the right track. Thanks to the boy scouts, however, there are fewer such misfits than there used to be, for, as almost nothing else we have, scouting tends to bring a boy face to face with the career for which he is best fitted. Thousands of youths today are on the way to make distinct successes of their lives because of the inspiration and early training they received in the local scout troop.

Last year surveys were made at nine institutions of higher education to determine what percentage of the students had been scouts. Here is the way they showed up:


Scout Friction Fire Outfit
Sketch by G B Ripley
Socket for left hand
Right hand at easy height
Hex spindle about 12" long and ½" to ¾" diameter
Keep close to and parallel with ground
Flat thong
Board ½" to ¾" thick
Hole worn by spindle
Wooden tray holding smoking black pyramid of powder
Drop in nest of crushed red cedar bark, and blow

THIS IS ALL THERE IS TO IT

A few pieces of wood, a flat thong, a pinch of powder and you have a fire-making kit The only thing that remains is the knack of working it

	Percent
Washington and Jefferson College, all classes	64
University of Oregon, freshmen	52
United States Naval Academy, all classes	50
Harvard University, all classes	49
Rhodes Scholars for 1925	48
United States Military Academy, all classes	48
University of Michigan, freshmen	44
Yale University, all classes	38
Lafayette College, all classes	33

The percentage of former scouts among college men is especially impressive when it is considered that the 613,087 scouts constitute only a small percentage of the boys of scout age in the country.

Not only do the scout-trained boys bulk large in numbers among college men but they stand out by reason of the quality of their scholarship Thirty-two college men won Rhodes Scholarships in 1925. Fourteen of them were scouts, and of the remainder, four expressed regret that they had never been scouts, a fifth praises scouting highly and a sixth is acting as an assistant scoutmaster.

A typical scout in college is Dudley Smith, of Independence, Missouri. Dudley joined the scouts at the age of 13 and devoted his spare time signaling, camp cooking, swimming, firemaking, first aid and other scout work Passing the tenderfoot, second and first-class tests, he began to earn merit badges for the life, star and eagle scout standing. One of the subjects he took up was bee keeping His interest brought him a hive as a birthday present, under his care it grew to eight hives The honey he sold brought money for camping trips and for many other pleasures.

To earn a merit badge in dairying he took charge of the family cow, marketing the milk. Winning badges, in short, led him to good scholarship, health habits, scientific study, research and experimentation.

Making fire by friction especially interested Dudley Trying it first with a home-made set made from a sketch took him more than five minutes. Then he began experimenting His research in spare time, trying various bows, hearths, spindles, tops, tinder and thongs, extended over three years. Every month or so he lowered his record a bit. Soon he began to break records and one day made a new speed record for scoutdom in making fire by friction.

Other scouts began urging him to make fire-making sets for them. Scoutmasters began ordering sets by the dozen, then by the hundred Eventually he had a fire-set business that has earned him enough money to start him in college. He is now finishing his second year and sees the rest of his college course coming to him through scouting

Their Knowledge Put to Use

More and more the scouts are concentrating on science. Here and there troops are establishing museums for specimens they have collected. At Bear Mountain last year 12,000 scouts were encamped; smaller camps dotted the country And every one of the campers was a science student. It is in the minds of the directors to have scientists going from camp to camp instructing the boys, but the scouts will continue to do their own research, going direct to the heart of things and finding out for themselves, as all scientists should.

What the boys learn is of direct and practical value. How often do we pick up a newspaper and read some such headline as. "Scout's First Aid Saves Chum's Life," "Scouts Fight Gipsy Moth Plague," "Scouts Building Trails Through National Forests"? Good, scientific jobs, all of them.

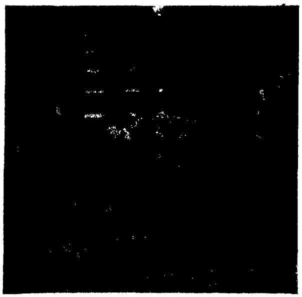
Men study sciences in colleges and universities, and after four years receive the degree of B.S.—bachelor of science But there is another B S. degree—boy scout. It too, means science, and who shall say that any other degree augurs better for the future of our country.

NOT A NAIL IN IT

This miniature bridge made by a scout of Santa Clara County, California, staunch enough to support an automobile, suggests the strong foundations the scouts are building on

DANIEL CARTER BEARD

The National Scout Commissioner, friend of boys for half a century, and loved throughout the nation, is the "grand old man" of scoutdom. He founded the organization in 1910



MATCHLESS SKILL

Scout Dudley Smith demonstrates how to have fire going in seven seconds Starting a blaze by friction is an accomplishment everybody in the organization strives to learn

Odd Pieces of Change

A Weird Miscellany of Queer-shaped Coins Have Been the Forerunners of the Round Flat Money of Today

By Howland Wood
Curator, American Numismatic Society

THE general conception of a coin or piece of money is that it is round and flat. This form has stood the test of centuries and, in fact, is a refinement and gradual improvement of the earliest coins. It is the common-sense form, because it is the most adaptable for carrying, storing, handling and counting. There have been, however, so many exceptions and there are so many odd shapes in coins, that a casual survey of the field is of interest.

The first coins were simply crude lumps of metal bearing a simple stamp. For the most part they were globular in general form; but, as time went on, they became flatter and more circular. The absolute flatness of the two sides, so that all raised parts should sustain an equal wear, apparently was not a major consideration until fairly modern times. Although the general circular shape was adopted early, exact roundness was not universally attempted until modern coinage methods came into vogue a few centuries ago. For the most part, we must look to the Orient for odd-shaped coins, although Europe and America provide examples of every period.

In parts of the world where there is a lack of minting facilities, we find coins, now and then, in the shape of bars, or that were obviously made from bars. One of the commonest examples is the bar money of Java and Ceylon. These coins were made from long, cast-copper bars, cut into different lengths according to the denominations of the coin to be made. In Siam, silver ingots were beaten into bars which were then pounded into peculiar shapes. The older shapes show a deep cut in the middle and two peculiar bendings. Later shapes were made into a more compact form known as "bullet money."

"Coins" Weighing 48 Pounds

Closely related to this form are pieces of money made from wire. The commonest examples are known as larins or "fish-hook-money," probably first made in Laristan, in Persia. These are pieces of silver wire about three inches long, doubled over, with one end curved. Similar pieces were made in Ceylon; and other straight pieces of wire were used in parts of India. Similar shorter pieces in copper, though still bent double, were used at Nejd, in Arabia, and in Georgia, in the Caucasus.

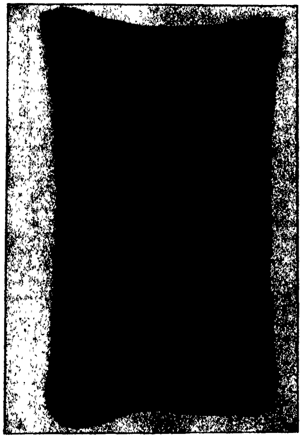
For over a hundred years, in the Seventeenth and Eighteenth Centuries, large flat copper plates bearing several small stamps on them came into use in Sweden. These cumbersome pieces ranged in denomination and size from ten dalers—weighing about 48 pounds and measuring nearly two-and-a-half feet long by about a foot wide—to small square pieces of less than an inch in diameter.

During sieges of cities and in periods of necessity when temporary and emergency mints were established, many silver coins were cut from sheets of silver into square, octagon or irregular shapes, and stamped with small punches. An interesting example of a piece of money cut from a silver bowl and still showing the rounded rim is afforded by a piece struck at Landau in 1702. During the Sixteenth and Seventeenth Centuries, many coins normally made round were often, for special reasons, such as commemoration, made square, hexagonal or octagonal.

India has always been partial to square coins. The earliest pieces, known as "puranas," were square pieces of silver bearing a number of small stamps. During the Bactrian period, and later, many coins in copper and silver were struck from square dies.

Many medieval coins, especially the very thin pieces known as "bractiates" issued in the Twelfth and Thirteenth Centuries, chiefly from Switzerland, were simply square pieces of sheet silver. These bractiates are interesting in themselves. They are as thin as paper, with a design in high relief on one side and countersunk on the other.

In the gold-mining days in California, fifty-dollar gold pieces, known as "slugs," were struck in an octagonal form. In recent years, the more easily to distinguish them from silver coins, nickel money was introduced in odd shapes. The recent British Indian coins are illustrations of this practise. The one-anna piece is scalloped; the two-anna piece is square, with rounded corners; and the four-anna piece is a scalloped octagon. Several of the nations have made their nickel coins round, but with a central hole to make them easily distinguishable.



A PRODIGIOUS COPPER COIN

In Sweden, during the Seventeenth and Eighteenth Centuries, copper plate money was stamped with dies. Some of these were nearly two and one-half feet long

The Mogul Emperor Akbar, in 1574, struck a gold coin of a peculiar pattern in Agra, India, which is known as a "mihrabi mohur," because its shape resembles a "mihrab" or prayer niche in a mosque. Some of the most peculiar conceptions of coinage emanate from Burmah and the Malay Peninsula. The Siamese coins have already been mentioned; but to the north and to the west, on the Burmese border, are found long, rough, cast-copper bars, and some smaller pieces cast in the shape of canoes. At Pahang, in the Malay Peninsula, tin coins somewhat resembling square hats with a wide brim were in general use at one time. At Kedah, small oval tin coins and pieces in the shape of a rooster on a series of rings, were used as currency.

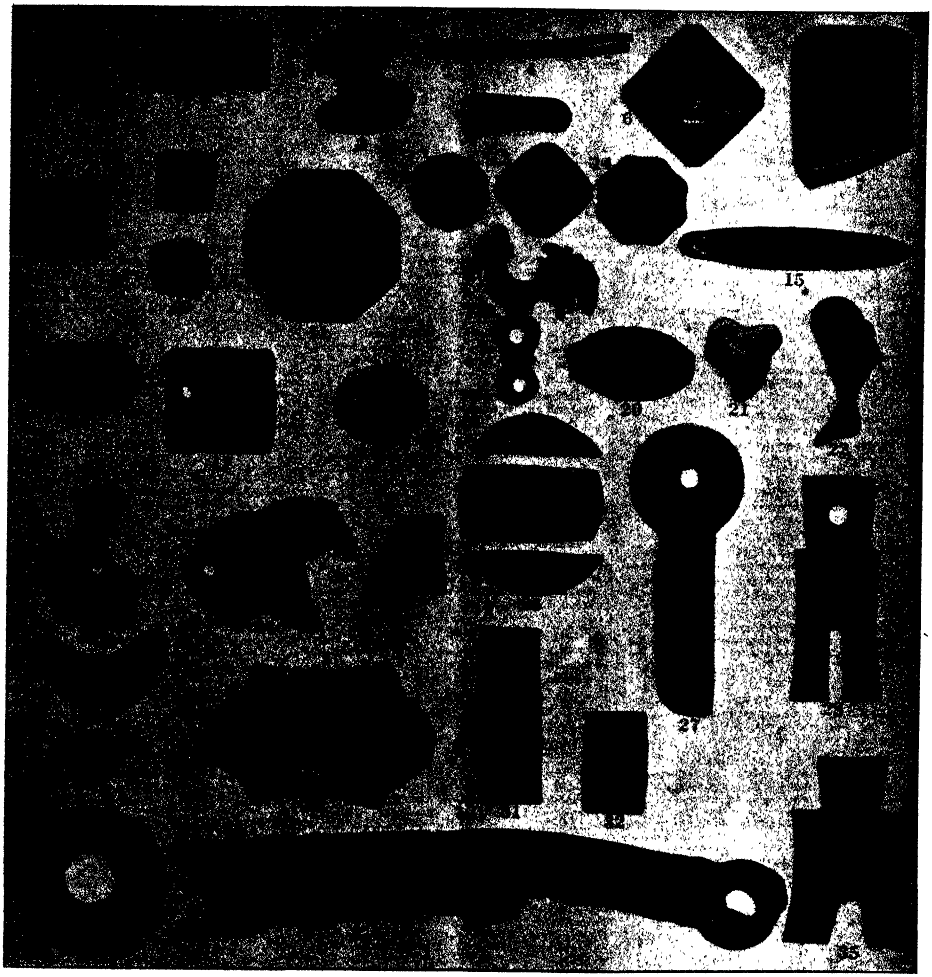
The ancients seldom deliberately made coins departing very much from the round or globular shape. There are, however, a few noted examples. At Olbia, on the Black Sea, there was coined a bronze piece in the shape of a dolphin; and in Italy, at Iguvium, certain almond or oval-shaped copper coins were made. There is also a class of coins of irregular shape which were largely the result of indifference or carelessness. Some of the ancient Greek and Roman coins are most irregular, due to the hastily or poorly fashioned planchets on which the pieces were struck. Many of the copper coins of Georgia, made in the Middle Ages, show that often they were struck on pieces of metal which had been simply poured out onto a flat surface, as were, in a similar way, many of the silver pieces from the various mints in Spanish America.

Coins originally round have often been made fantastic in shape by cutting. This was practiced to some extent in ancient times and during the Middle Ages. But the most curious, and possibly the most common, practice was that employed in the West Indies from 200 to 100 years ago. On these islands, large quantities of Spanish dollars or pesos were cut to make small change or to make the pieces conform to new monetary standards. The commonest practice was to cut a dollar into segments, quarters, sixths, twelfths, et cetera. Sometimes the piece was simply cut in half. On some of the islands, they were cut into three horizontal pieces. Often holes of various sizes and shapes were made in the coins, when both the plug and the ring were used.

Bizarre Shapes Prevailed in the Orient

So far, no mention has been made of the coins showing Chinese influence. In this series alone are found many bizarre shapes. To understand the reason for some of these shapes, it is sufficient to say that the first Chinese coins were a transition from the barter stage, and the forms employed were similar to the units of value from which the coins were derived. The most common of the ancient forms were what are known as "knife coins." These were in common use for several centuries before the Christian Era. Another common type is known as "Pu," or weight, fork or spade coins, derived probably from some agricultural implement. Both of the above forms were revived a few centuries later by the usurper Wang Mang, about the beginning of the Christian Era. For silver, the Chinese have used for centuries, cast ingots of special forms. The most common shape is known as "shoes" which weigh from a fraction of a tael to fifty taels. In Annam, one of the most common forms of silver or gold money is the rectangular bar of varying sizes. In Japan, about 1860, gold and silver money appeared in thin oval sheets, or smaller and thicker rectangular pieces.

A survey of the numismatic field shows that except in the Orient, coinage as a whole has been flat and round, and that when deviation from this practise has occurred, it has been largely a matter of temporary expediency, experimentation, or effort to distinguish a particular coin from those coins in current use. For easy identification, the odd-shaped pieces of recent years have usually been of nickel.



These Were Once Used As Coins

1. Early Greek coin showing globular shape. 2. Coin cut from piece of copper bar made by the Dutch in Java about 1800. 3. Early Siamese coin cut from silver bar and then bent. 4. Silver wire money from India. 5. Georgian coin made from copper wire. 6. Coin struck at Haarlem when besieged by the Spaniards in 1572. 7. Coin issued during the siege of Landau in 1702, showing the rounded edge of the silver dish from which the blanks for the coins were cut. 8. A Bactrian coin of India. 9. A square rupee of Akbar the Great of Hindustan. 10. An early small silver coin of Switzerland known as a "bracteate." 11. The octagon slug of California struck in the early gold-mining days. 12, 13, 14. Types of recent British Indian nickel coins. 15. Canoe-shaped coin from the Lao States, north of Siam. 16. The "Mihrabi Mohur," of Akbar. 17. The "tin hat" money of Pahang. 18. An oval coin from Kedah. 19. A most bizarre coin from Kedah. 20. An oval copper coin made at Iguvium, in Italy. 21. A Greek coin of the Island of Aegina, struck accidentally on an ill-formed planchet. 22. Many of the copper coins of Georgia in the Middle Ages were struck on odd-shaped plans. 23, 24. Seventeenth Century Mexican coins struck on irregular pieces of metal. 25 A Spanish dollar, cut in quarters, used for money in the West Indies 26. Small change of the Island of St. Lucia 27, 28. Chinese coins made about the beginning of the Christian Era. 29. A silver tael known as a "shoe." 30. Form of Chinese Sycee silver. 31. An Annam silver coin. 32. A Japanese silver coin at the time when Commodore Perry landed. 33. Holed Spanish dollar used for 16 Bits at Dominica, and the piece extracted used for two bits. 34. An early form of a knife-shaped coin of ancient China. 35. This is a coin of ancient Cathay and is known as Pus.

X Rays and Atoms

By Means of Crystals or Powders the X Rays Are Diffracted or Reflected in Definite Patterns. These Enable the Analyst to Deduce the Arrangement of the Atoms Within the Crystals

WITHIN recent years the X rays have become an important link in the chain of researches on the constitution of matter. The atoms and molecules, with which these researches are mainly concerned, are far beyond the limits of observation of the finest microscope.

At the same time, the problem of the structure of crystals, having important bearings on the constitution of matter, has offered such difficulty, that heretofore it has received less attention than other branches of science. *

The whole subject, however, has gained greater interest, from the discovery that X rays could be diffracted by means of crystals This discovery, made by Friedrich and Knipping at the suggestion of Laue, established the fact that X rays were in reality light of a wavelength about 10,000 times shorter than that of visible light. A wide field of investigation was thus suggested, and physicists have since done much work on the determination of the arrangement of atoms within crystals or powders, and in the measurement of the wavelengths of X rays.

Using Atoms for Mirrors

In the application of Laue's suggestion, made by Friedrich and Knipping, a thin pencil of "white" X rays (that is mixed X rays of a number of different wavelengths) was passed through a crystal plate, and a photographic plate, placed a short distance beyond the crystal, recorded the reflected pencils as a number of regularly disposed dots. (Figure 1 shows the arrangement of the apparatus)

A recent example of a Laue crystallogram is shown in Figure 2, in which benzil was used as the diffracting object From this and other photographs, certain symmetry relations of the crystal may be deduced

The Vindication of a Theory

In 1912, Laue, an Austrian scientist, suddenly conceived a brilliant idea, notable for its utter simplicity. "Why not use the atoms within crystals as a diffraction grating for X rays," he asked, "just as we now use glass plates ruled with 20,000 parallel, diamond-cut lines per inch as diffraction gratings for light?"

Laue knew that X rays are identical in nature with ordinary light, except that their wavelength is 10,000 times shorter. Yet, to rule 10,000 X 20,000 parallel lines on glass would prove hopelessly out of the question. We cannot work that minutely.

But had not Nature already provided as good and as minutely spaced a grating as this would be, in the form of crystals? Mineralogists had said, on purely theoretical grounds, that the atoms of crystals were of a certain pattern and spacing, and that they were arranged in rows and tiers, like boxes packed into a room.

An experiment with crystals and X rays was quickly tried. It worked! Laue had reasoned right. The mineralogists had also theorized correctly. The X rays were seen to be diffracted by the atoms of the crystals in a beautiful, geometrical pattern. Despite the fact that no microscope has ever revealed an atom (so small are they), yet for most practical purposes we could now "see" them, because we could put them through certain performances and note the visible effects. It was like a blind man feeling out the contents of a room with a stick.

From these experiments we have learned much about X rays; also we have learned much about the actual structure of matter.

(In application, X-ray analysis is somewhat technical, yet it is extremely interesting and revealing. A notable work covering this subject is "The Structure of Crystals," by Ralph W. G. Wyckoff.)

A brief explanation of the way in which the crystal structure affects the X rays may be given as follows: In one position (among many others) in the crystal, a number of atoms lie in a plane or "space-lattice." At a particular angle a pencil of rays reflected from the plane is retarded one wavelength behind a pencil reflected from an adjacent atom plane. In other words, the waves are "in step." The effect of this is that these pencils and others from parallel planes reinforce each other, and combine to form a beam sufficiently intense to form a dot on a photographic plate.

A little thought will show that there is more than one angle of reflection in which there is a wavelength retardation; also that there are other angles of reflection in which this condition is secured for X rays of other wavelengths. A further complication lies in the fact that the atoms in adjacent planes may be those of different elements with different spacings and different atomic weights. It is therefore difficult to deduce anything more than the fact that a simple crystal possesses certain properties of symmetry.

Improvement Quickly Followed

An improvement on Laue's method was made by W. H and W L. Bragg, who used a thin beam of "monochromatic" X rays (or X rays of only one wavelength) and obtained the reflection of this beam from selected atom planes of crystals. The reflection, although following the ordinary law that the incident and reflected angles are equal, has a perceptible intensity only when the vibrations in the beams reflected from a number of successive atom layers reinforce each other. In the direction where this is the case, a line is formed on the photographic plate.

In general, the X rays consist of a number of

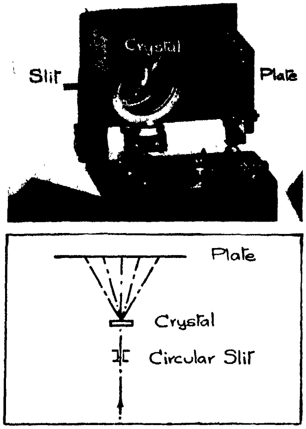
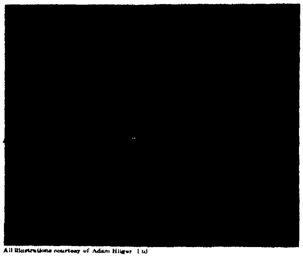


FIGURE 1

ABOVE: *Simple apparatus for crystal analysis* BELOW. *A diagram of the apparatus shown immediately above*



All Illustrations courtesy of Adam Hilger Ltd

FIGURE 2

A Laue crystallogram The diffracted X rays produce dots in pattern on the photographic plate

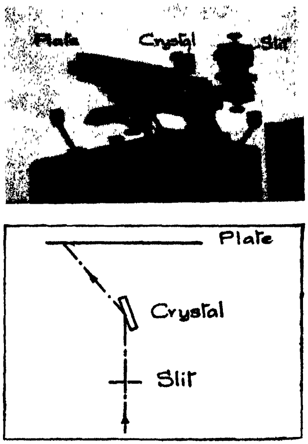


FIGURE 3

ABOVE: *Bragg's arrangement. Here the rays are reflected.* BELOW: *A diagram of the Bragg arrangement*

FIGURE 4
Two spectrograms made by the Bragg method Each wave length produces at least one line on the plate

different wavelengths, each of which gives at least one line on a suitably placed photographic plate. The whole series of lines constitutes an X-ray spectrum.

In Bragg's arrangement (shown in Figure 3) the X rays are passed through a narrow slit: they are then reflected from the crystal and recorded by the photographic plate. The crystal is oscillated through a given angle and at various orientations, the wavelength, atom plane spacings, and the glancing angle, are connected by a simple formula. At these points a line is recorded by the photographic plate, and the result is an X-ray spectrogram Two examples of these spectra are shown in Figure 4.

The Powder Method

The very rapid advance made in the knowledge both of X rays and of crystal structure due to the introduction of the Bragg reflection method showed that the value of this method for investigating substances would be greatly increased if these substances were not needed in crystals of appreciable size. The necessary modification of the Bragg method was introduced independently by Debye and Scherrer, and by Hull, and consists of mounting the substance in powder form at the center of a cylindrical film A pencil of monochromatic X rays falling upon a rod of such powdered crystal is reflected and photographed as a number of curved lines. The lines corresponding to all cleavage or atom planes are photographed at once and thus only one photograph is necessary. Figure 5 shows the arrangement, and Figure 6 shows two examples of Debye X-ray spectrograms taken on Dr. Muller's X-ray spectrograph.

In the case of Hull's method, a piece of paper is

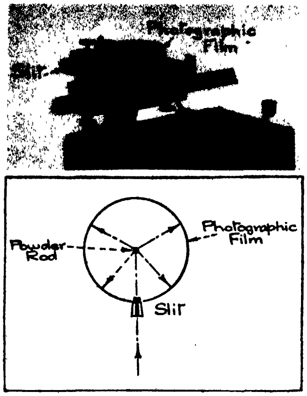


FIGURE 5
ABOVE *Apparatus for the powder method* BELOW · *A simple diagrammatic sketch of the apparatus shown above*

coated with a layer of powdered crystal and this is placed close to and across the opening of a thin channel through which the X rays pass The thin beam of rays is reflected and lines are recorded on a flat photographic plate placed a short distance away

In order that physicists may become familiar with one or more of these methods it is essential, in view of the depleted resources of most laboratories, that a comprehensive outfit, for a reasonable outlay, should be at their disposal. The X-ray spectrograph, designed by Dr. Muller working under Sir William Bragg at the Davy Faraday Laboratory, and made by Adam Hilger Ltd. (London), meets these requirements fully and enables all of the above methods to be used.

Figures 7, 8 and 9 show the spectrograph in operation, taking Bragg X-ray spectrograms

Figure 7, shows the operator in the act of controlling the vacuum in the Shearer tube. Referring to the latter, this is a convenient means of producing X rays of the desired kind, and consists of a water-cooled vacuum tube, the vacuum being produced by suitable pumps. The necessary high voltage is secured by the use of high-tension transformers running on alternating current.

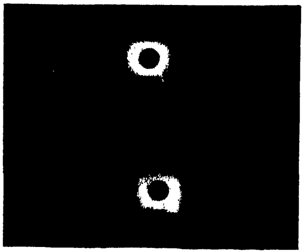


FIGURE 6
Spectrograms made by the powder method. The X rays are photographed in a number of curved lines

Figure 8 shows the instrument with the lead safety screen removed, and Figure 9 shows a clearer view of the Shearer tube.

Crystal analysis has also contributed to metallurgy to an invaluable extent. Dr W. P. Davey of the research laboratory of the General Electric Company has demonstrated why different metals and different alloys of metals can have different properties

Why Some Metals Are Brittle

A piece of metal is usually composed of small crystals irregularly arranged It has been found, for example, that the ductile metals crystallize in a cubic arrangement, an atom being at each corner of the cubes Brittle metals have a similar arrangement of the atoms, except that there is also one atom in the actual center of each cube. When these unit cubes are built up, thousands on top of thousands, lines of atoms are noticeable in several directions, just as in an orchard there are many directions in which the trees are in parallel rows Extending these rows into the third dimension, similarly parallel planes are produced and it is on the arrangement of these planes that the qualities of the metals seem to depend

"The structure of metals undergoes striking changes during the processes of preparation," says Edgar C Bain, in *Industrial and Engineering Chemistry* "Many manifestations of these changes may be followed by the microscope, but others are too subtle for this method of observation" Sometimes, continues this writer, these changes are due to atomic arrangement phenomena, and it is in this field that the study of X ray diffraction of metals has proved a tool of research not incomparable with the metallurgical microscope in value to metallography.

FIGURE 7
How the operator controls the vacuum in the Shearer tube

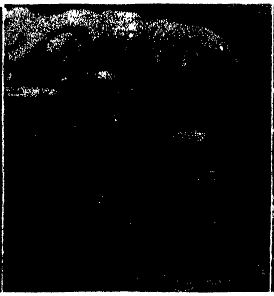


FIGURE 8
The same as Figure 7, with safety screen removed

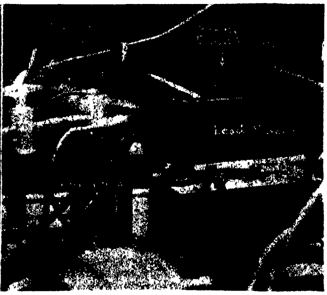


FIGURE 9
A clearer view of the Shearer tube than Figure 8 affords

Specially drawn for the Scientific American by Arthur T. Merrick

THREE FLIGHTS TO THE NORTH POLE

This drawing shows the routes which will be taken by the expeditions of Captain Amundsen, Captain Wilkins and Lieutenant Commander Byrd

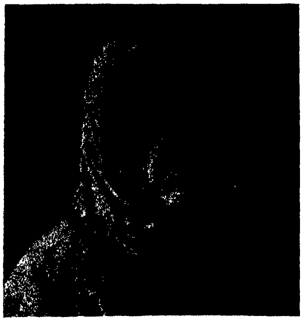
Eavesdropping on the Arctic

Radio Fans Will Comb the Ether for Messages from the Aviator-explorers Racing to the Pole

By Orrin E. Dunlap, Jr.

THERE is no east, west or north at the top of the world and therefore thousands of short-wave radio receivers on all sides of the earth will have an equal opportunity to tune in the messages broadcast by the aviator-explorers participating in the race to the North Pole this summer. The etherial channels originating in the ice-capped region will be sprayed across the globe in much the same fashion as the lines of longitude radiate from the end of the earth's axis and spread out over the surface of the sphere.

Twelve arctic expeditions are in preparation and three are ready to hop off from northern points of land into the cradle of storms. All plan to use radio because of MacMillan's success in communicating with civilization last year while nestled in the ice packs off Greenland. Newspaper reporters, accompanied by radio operators and wireless equipment, have established a base at Point Barrow, Alaska, from where they hope to pick up and then relay the greatest news story of the year. It is expected that many amateurs operating short-wave sets will hear the narrative first hand from the explorers within a fraction of a second after the words are released into the northern air, because low wavelengths skip over short distances and travel far.



Wide World

CAPTAIN ROALD AMUNDSEN

The Amundsen Ellsworth transpolar flight expedition has a route from Rome to Nome, via Spitsbergen

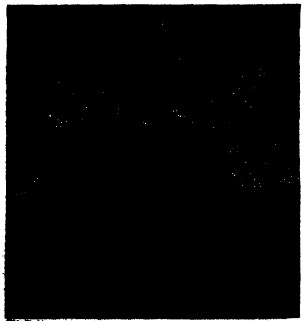
Wide World

LIEUTENANT COMMANDER RICHARD E. BYRD

He expects to keep in communication with the world on the 13-meter channel and auxiliary wavelengths. He will use the call letters KEGK, assigned to the S.S. Chantier

Lieutenant Commander Richard E. Byrd, leader of the flying expedition financed by American citizens among them John D. Rockefeller, Jr., and Edsel Ford, each contributing $20,000, expects to keep in communication with the world on the 13-meter channel and other auxiliary wavelengths. The wireless operators are L. K. Grenlie of Chicago and G. H James of Manchester, Massachusetts, both former corporals in the Marine Corps. They will use the call letters KEGK assigned to the *S.S. Chantier*, the Shipping Board's steamer, fitted for work in icy seas and capable of carrying fuel sufficient for the planes to fly 10,000 miles.

Byrd's first flight will be from Spitsbergen to Cape Morris Jesup, Peary Land, North Greenland, the most northerly known land just 450 miles from the North Pole. There the base will be established so that the airmen can have a ready supply of gaso-



Wide World

CAPTAIN GEORGE H. WILKINS

His base is at Point Barrow, Alaska. He plans, if land is discovered, to make a non-stop dash for Spitsbergen line and food. Two trips will probably be made to carry the supplies from King's Bay to Peary Land, a distance of 450 miles.

Owners of short-wave receivers are likely to hear dispatches radiated from the North Greenland base on the 13, 20, 40 and 80-meter channels. The Naval Radio Research Laboratory at Bellevue, D. C., and the Marine Corps at Quantico, Virginia, have built special equipment to detect the 13-meter signals because many of the amateur circuits are not designed to tune much below 20 meters. Use of the 13-meter channel was stimulated by the record of Dr. A. Hoyt Taylor of the United States Navy in sending messages across the United States to Oakland, California, in daylight on the 13.1-meter wave with a transmitter output of 250 watts.

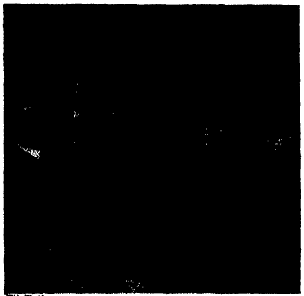
Commander Byrd expects to exchange weather and news with navy, amateur and experimental stations on all sides of the world. The steamer *Chantier* carries a 1-kilowatt navy spark installation, capable of broadcasting on 300, 600 and 800 meters, also a special short-wave, one-quarter-kilowatt, vacuum-tube transmitter operating on 500-cycle current. Naval engineers estimate that the short-wave set will cover twenty times as far as the *Chantier's* spark.

The receiving equipment consists of one navy standard circuit, designed for ship-to-ship communication and long-wave reception from the high-power transatlantic stations and from Arlington, Virginia, also two short-wave sets and two broadcast receivers for reception of entertainment.

Radio Will Play Important Role

The plane's transmitter will consist of one 50-watt vacuum tube and associate apparatus equipped with a piezo crystal to insure a constant frequency despite the vibration and movement of the airship. It will be tuned to broadcast on 61 and 44 meters covering a range estimated to be approximately 1,000 miles. The plane will also carry a portable short-wave receiver for use in case of forced landing. The generator is wind-driven but by means of a special gearing it can be cranked by hand. In case of an emergency landing, kites will be used to hold the antenna aloft and incidentally to serve as marking streamers.

Before leaving the United States in April, Byrd pointed out that radio would add an element of drama to the polar contest because he expects to maintain communication with Wilkins and his companions who are approaching the goal from Alaska and with Amundsen's dirigible sailing up from the European side of the globe. He said that they hoped to receive each other's messages and in case of distress one may be able to aid the other.



Wide World

A VOICE FOR THE ARCTIC

Short-wave transmitter on board the Chantier, Commander Byrd's ship Malcolm Hansen, designer of the set, is at the left, operators G H. James and L K. Grenlie at the right

Commander Byrd's airplane transmitter was designed by Malcolm P. Hansen of the Navy and is similar to the one carried on the expedition of Captain George H. Wilkins, the Australian explorer who is backed by the American Geographical Society, the Detroit Aviation Society and the North American Newspaper Alliance. Captain Wilkins will also use the air in an attempt to discover unknown territory which is thought to exist in the region north of Alaska and Siberia.

The Wilkins' base has been established at Point Barrow, Alaska. He plans to wing his way in a Fokker plane across Beaufort Sea toward the Pole and, if land is discovered, a non-stop dash for Spitsbergen, a distance of 1,747 miles, may be attempted. It is 2,600 miles from Point Barrow to the Pole and back. If the trip is successful, the short waves radiated by Captain Wilkins' operator will tell the world what the veritable hub of the universe looks like from the air.

The Amundsen-Ellsworth transpolar flight expedition has a route from Rome to Nome via Spitsbergen in the *Norge*, a 400-cubic-foot semi-dirigible designed by an Italian, Signor Nobile, who will command the craft. There are eighteen in the party, including Raold Amundsen, discoverer of the South Pole and Lincoln Ellsworth, the American who flew into the arctic with the Norwegian explorer last year, only to be turned back when within 292 miles of their goal—the North Pole. This expedition is sponsored by the Aero Club of Norway and the Italian Government. Amundsen explained that the aim of his expedition is to obtain greater geographical knowledge, which radio waves will probably carry south as the big ship sails over the barren wastes in the north.

Captain Amundsen said that he hoped to be able to radio reports of the *Norge's* progress at every degree of latitude, giving the world, "an exciting narrative for at least 65 hours." The existing wireless stations at Nome and Kotzebue Sound will be kept busy handling the traffic from the north and in maintaining watches for SOS calls in case some of the aircraft drop to the icy surface and are unable to find a smooth run-way to hop off again into the sky.

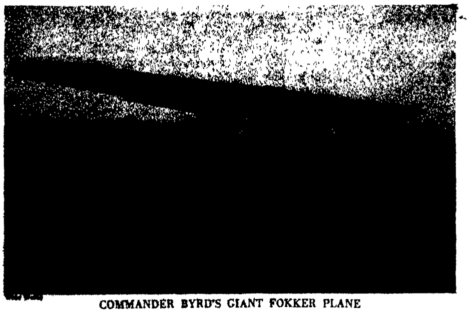
Captain Berger Gothwaldt, radio expert on the *Norge* hopes to talk with American and European stations all the way by means of the Marconi set designed to cover a radius of 1,000 to 2,000 miles. In preliminary tests the receiver picked up many of the large European stations and proved its worth as a direction finder. The high-power station at Stavanger, Norway, answering to the call LCM, will broadcast on regular schedules, weather reports gathered from the northern regions of Canada, Russia, Siberia, Alaska and Norway.

Other Expeditions Going

Another expedition headed by Lieutenant Leigh Wade, an American around-the-world flyer, assisted by Lieutenant H H. Ogden, another aviator who encircled the earth, supported by the alumni of several colleges will strive to make a round trip to the top of the globe this summer Five Douglas planes will be employed in this attempt, which has been organized by Robert A Pope.

Those who have short-wave apparatus tuned in on the north will also have an opportunity to pick up news from the following expeditions which will get under way later than those already mentioned: Robert A. Bartlett Expedition, equipped with airplanes and with the North Pole as an objective; the French Polar Flight led by Captain Jules de Paver to take off from Francis Joseph Land for a trip to the Pole; the Swedish-Hammer Polar Flight; the British-Norwegian expedition captained by Colonel Tryggve Gram; the Soviet Polar Flight in the airship *Lenin*; MacMillan's expedition to find more evidence of the Norseman's visit to Laborador; an expedition led by Harrison Williams and backed by the American Museum of Natural History and George P. Putnam, which will cruise the seas around Greenland in search of scientific data

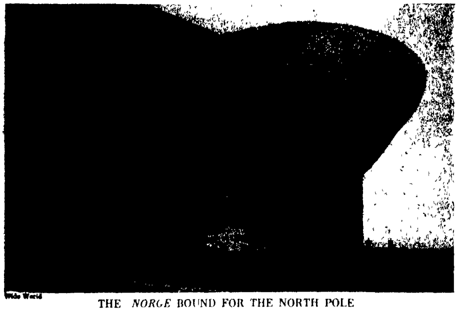
The main object of all flyers will be to reach the Pole and explore parts of the 1,000,000 square miles of "lost continent" known as "Area X."



Wide World

COMMANDER BYRD'S GIANT FOKKER PLANE

Operators of short-wave sets are likely to hear the messages which will be sent from this plane when it flies over the arctic regions



Wide World

THE *NORGE* BOUND FOR THE NORTH POLE

***Amundsen** hopes to broadcast messages at every degree of latitude, giving radio fans an exciting narrative for at least 65 hours*

BATTLE PRACTICE. SALVO FROM THE 14-INCH GUNS OF THE NEW MEXICO

The Manufacture of a Battleship's Turret Guns

From the Molten Steel in the Furnace to the Finished Gun on the Ship

By Lieut. Comdr. W. H. P. Blandy, United States Navy

THE turret guns of our battleships—those powerful and ponderous weapons which throw tons of steel across miles of space with marvelous accuracy—are highly worthy specimens of the steelmaker's and machinist's arts. The finest grade of steel obtainable in large forgings goes into their thick walls, and probably nowhere is such precision demanded in heavy machine work as is required in turning and boring their various layers. For these giant rifles are not made from a single mass of steel, as might be supposed from the brief glimpse occasionally afforded in the "News Weeklies" at the movies. They are built up of numerous layers of forged steel, each assembled upon the next inner member with just the right pressure at the contact surface to afford proper support, without causing undue strain in any part, when the terrific firing pressure is developed in the bore.

How the Forgings Are Made

The rough steel forgings are made of acid open-hearth steel. The component materials used must themselves be almost entirely free from impurities which would cause defects in the finished forging. A typical furnace "charge" for a nickel steel "hoop" to be used on a 14-inch gun is as follows, in rough measure:

13	Tons	Nickel Steel Scrap
20	"	Low Phosphorous Pig Iron
11	"	Nickel Steel Turnings
20	"	Steel Plate
1	"	Metallic Nickel
65	Tons—Total Charge	

These constituents are loaded into the furnace and about nine hours are necessary for melting, and about six more for refining. Iron ore is added to the molten bath to assist in oxidizing the carbon and impurities; while the small additional quantities of nickel, silicon, and manganese required are added as the "heat" progresses. If the carbon gets too low, spiegel or pig iron is added to recarburize. Chemical tests of small specimens drawn from the bath toward the end of the heat show exactly whether the correct proportions of all elements are being obtained, and when such is finally the case, the burners are shut off for about 20 minutes to allow the molten metal to cool in the furnace to the pouring temperature. This period also allows slag particles and gas to rise to the surface.

The molten metal is now poured into the ingot mold. Then, when the ingot has cooled to such a degree that the outside is solid and firm, the mold is stripped from the ingot, and the latter buried in ashes to insure slow cooling.

The next step, after the metal has been cast in the form of an ingot, is forging. The ingot is heated in a furnace to a white heat. It is then carried to a forge press, and the top and bottom "discard" (containing impurities) is sliced off. The remainder is now set upright and "upset" by the press until its length is greatly reduced. A die is then punched down through the center of the ingot, making it hollow. You begin to see possibilities of that white spongy mass becoming part of a gun after all.

Courtesy of the Midvale Company

FORGING UNDER HYDRAULIC PRESS

The white-hot forging is slipped over a mandrel and forged down to shape in this 9,000-ton press

A long, cylindrical mandrel is now thrust through the central hole in the ingot; and as the white-hot steel is repeatedly pressed by the forging die, and the mandrel is revolved, the metal works out along the mandrel until the forging has been transposed from a short squat cylinder of great wall-thickness, into a very long tube with a comparatively thin wall. The process of forging also closes up all "pipes" and "blowholes" in the steel as cast, breaks up the coarse crystallization, increases the cohesion of the crystals, and produces a silky, fibrous structure.

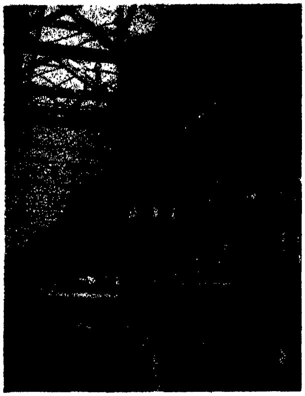
Fourteen Forgings for One Gun

The forging is now "annealed" to remove forging strains, and to complete the work of grain refinement. This process consists in slowly heating the forging to a definite temperature, holding it at that temperature for several hours, and slowly cooling it in the closed furnace.

The annealed and comparatively soft forging is now rough-machined. In its annealed condition, the steel does not possess sufficient strength, so it must receive a further heat treatment. It is heated in a vertical furnace to a white heat, and then plunged into a quenching bath of cool water—a most inspiring sight, which should not be missed by anyone who has the opportunity to witness it.

After the quench comes a "draw" in a horizontal furnace. This process greatly resembles annealing, but the temperature reached is much lower. Its purpose is to relieve quenching strains, temper the hardness to a degree permitting easier machining, and remove brittleness.

Specimens are now cut from the forging for phys-



LOWERING THE JACKET

The heated jacket, contracting upon the cold tube, holds it in a powerful grip. This greatly increases the resistance of the tube to the powder pressure

ical test. The testing machine measures the elastic strength (reached just before distortion occurs), the ultimate breaking strength, and the ductility. If these tests are satisfactory—and visual inspection discloses no defects—the forging is accepted provisionally by the Navy's inspector, and is delivered to the Naval Gun Factory at Washington, D. C. Assuming now that a complete set of forgings has been received at the Gun Factory, the work of building up the gun commences. The magnitude of this part of the job may be appreciated from the fact that 14 separate forgings have to be assembled to make one 16-inch gun.

The innermost cylinder is the "liner" in which the rifling is engraved. It exists for economy's sake, for when the rifling becomes worn, the gun may be made just as good as new by replacing the old liner with a new one, and then rifling the new liner.

But since the liner is very thin, it adds but little to the strength of the gun. It is therefore always the last member to join the family. Next outside the liner is the tube which, like the liner, runs the full length of the gun. Over the tube the jacket is shrunk on. The dimensions of the tube and jacket must be such that the outer diameter of the tube is larger by a few thousandths of an inch than the inner diameter of the jacket. The exact difference is called the "shrinkage." This is one of the most exact machine jobs performed anywhere on "big work," since the finished shrinkage surface must not vary by more than half the thickness of a cigarette paper.

The jacket is now heated in an electric furnace until large enough to pass freely over the tube, which has been placed breech downward in the "shrinking pit." The expanded jacket is lowered over the muzzle end of the tube, in the bore of which cold water is circulated to keep it from heating up and expanding.

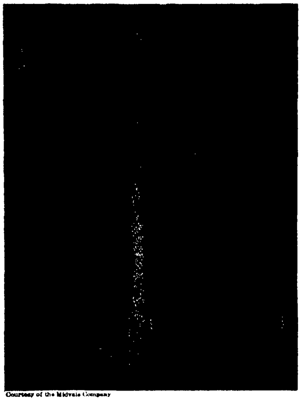
Shrinking Strengthens the Gun

As the jacket cools, it grips the tube until the tube is under compression and the jacket in tension. This combination enables the tube to withstand a higher powder pressure. In a thick-walled cylinder like a gun, an internal pressure makes its presence felt much more upon the metal near the bore than upon that near the outer surface. Hence, if the inner metal is initially *compressed*, it can stand a certain amount of internal pressure before it even *begins* to be *stretched*.

The other cylinders are shrunk on the assembled tube and jacket in the manner described for these two, and finally the whole gun, minus the liner, is placed muzzle downward in the pit, heated in place, and the cold liner lowered into it.

When the gun now cools, the work of assembling is finished. It is next "finish-bored" with the greatest accuracy possible—the only remaining machine work being to cut the rifling grooves. The "rifling head" is a cylinder carrying a number of cutting tools equally spaced around its periphery. It is fixed to the end of a long cylindrical bar, which is made to rotate as the rifling head is forced into the gun. The result is that the cutters engrave spiral grooves in the bore.

There remains only to attach the "breech mechanism," which has been undergoing its manufacture in a separate shop. This important part of the gun consists principally of a large block of steel, weighing nearly a ton for the larger guns, which is swung on hinges at the breech. When swung into its closed position, this heavy block screws into the breech and seals it against a powder pressure of sometimes more than 20 tons per square inch. In spite of the rather intricate mechanism involved, and the great weight of the breech-block, however, the opening and closing of the breech are done in the winking of an eyelid.



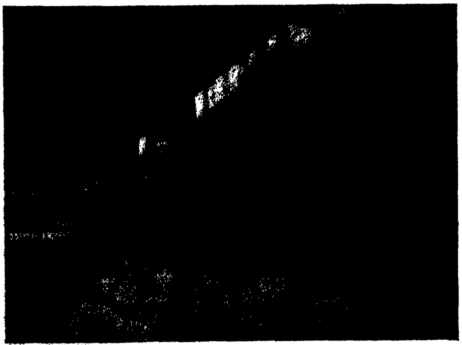
Courtesy of the Midvale Company

TEMPERING A GUN TUBE

The tube is raised to white heat in the lofty cylindrical furnace, seen back of the tube. It is then tempered by being lowered into a tank of oil

Although not a part of the manufacture, the final process necessary to the acceptance of the finished gun is its "proof." Several shots are fired from it, including at least one with an overcharge of powder, to prove that it can fire ordinary "service" charges on board ship, with perfect safety.

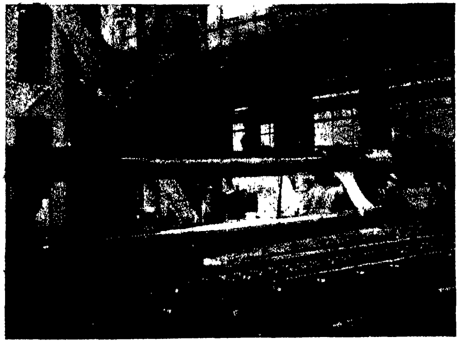
The tried and true defender is now placed on a barge or a railroad truck and started on the journey which carries it eventually to its floating home. There, housed in a grim gray turret, it maintains a silent watch over the nation's destinies, except for a few brief remarks made each year, more or less in jest. And if the occasion arises when it must speak in deadly earnest, rest assured that the word will be exactly to the point, and full of meaning.



Courtesy of the Midvale Company

POURING THE INGOTS

When the steel has been refined in the furnace, it is tapped into a large ladle, carried over the ingot molds, and poured through a hole in the bottom



RIFLING THE GUN

The rifling machine cuts a series of equally spaced grooves in the tube. These serve to spin the projectile and maintain it unerringly on its true course

Annapolis

The Famous College Where Our Future Admirals Receive Their First Training

By J. Bernard Walker

Photographs courtesy of U. S. Naval Academy

ANNAPOLIS, like its famous sister college, West Point, has the advantage of a fine scenic setting. Although it has not the background of forest and mountains which lends such charm to the military school on the Hudson, Annapolis has a beauty of environment which is all its own. Behind it nestles a lovely centuries-old town, with its many wonderful, red-brick colonial mansions. Before it the broad expanse of the Chesapeake gives the proper marine touch to the picture, while the long sweep of its lovely greensward, with its wonderful growth of stately timber serves to give an instant impression of dignity and very real beauty as one passes the entrance gates.

Except as regards the site and its rich traditions, the Annapolis that we see today is not the Annapolis in which the admirals and older ranking officers of our navy had their training. For the rapid growth of our navy since the Spanish War, and the corresponding increase in the number of midshipmen, called for a great enlargement of the accommodations and necessitated making a rather complete sweep of the older structures to make way for the vast and very impressive buildings in which the present academy is housed. Whatever sentimental regret we may feel at the change, it cannot be denied that the whole scheme of the new buildings has been carried out on a scale of dignity and convenience which renders Annapolis well worthy of the great navy which it serves.

Founding of Annapolis in 1845

In former days such famous sailors as Farragut began their sea training at the early age of ten—not in such an elaborate institution as we now see at Annapolis, but on board ship and under the tutelage of an officer who acted as sponsor for the young midshipman's training. "This practical schooling among the 'rough necks'—the flotsam and jetsam of the water fronts of big cities—produced some of the best officers and some of the finest traditions of the naval service; but such an environment for very young boys, while it was the making of the large majority, unmade countless others. Only very unusual characters could stand such a training." It was these conditions that led George Bancroft, the historian, when he was Secretary of the Navy, to found a school on shore for the training of boys for officers of the navy. Bancroft selected Annapolis as the site of his school and thus became the founder, in 1845, of the United States Naval Academy. The new Academy covers some 300 acres, much of it consisting of magnificent lawns, which are surrounded and shaded by many ancient trees. Around these wide-spreading lawns are picturesquely grouped in an architectural unit the vast granite and white-faced brick buildings, the athletic field and drill grounds, and the long stretch of the water front.

MAIN ENTRANCE TO BANCROFT HALL

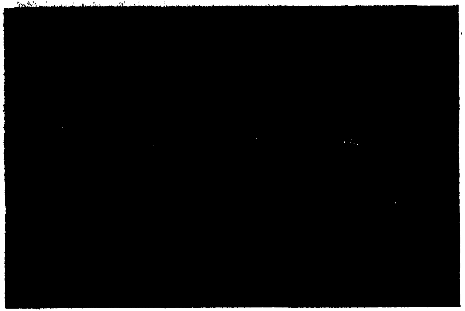
This magnificent building which, with its connecting wings, has a total facade of over 1,400 feet, contains living accommodations for 2,500 midshipmen

What is the aim and purpose of Annapolis? Broadly speaking, it is three-fold. In the first place, it is a college whose curriculum is more thorough, broader and more exacting than that of any four-year graduation course at any civilian college. There can be no denying that the midshipman who applies himself earnestly to the mastering of the course, leaves Annapolis with a broad and very thorough education. But it is the aim of Annapolis to do something more than give its inmates a thorough education; for it seeks to inspire these young men, to saturate them, with the finest traditions of the United States Navy, and to this end both within the grounds and in the various great halls of the institution is to be found an amazingly rich collection of relics of our navy, dating from its very earliest beginnings.

In the Chapel Sleeps John Paul Jones

In the crypt below the college chapel rests the body of John Paul Jones, who with good reason has been called "the father of our navy." And as one wanders through the grounds and passes through hall after hall of the buildings, he finds himself face to face with endless evidence in the way of statues, busts, oil portraits, autographed letters, famous historical sayings, tattered flags, captured cannon and a thousand other mementoes, which constitute in themselves a comprehensive history of the great sea captains and the major engagements of our navy from colonial days down to the great war.

But while we give full credit to the scholastic and traditional influences of Annapolis in the molding of these young men into the material out of which our future officers will be developed, there is one other, and perhaps the greatest, goal of all at which the sponsors of Annapolis continually aim, and that is to saturate the students with what we might call the spirit of Annapolis, to instil within them such a regard for veracity, honor, self-sacrifice and dignified patriotism, that these qualities will become, with each and every one of them, a second nature. More perfectly put, Annapolis aims to make every student a gentleman of the type which can be instantly recognised, whether you meet its representative in a presi-



AIRPLANE VIEW OF THE ACADEMY

In foreground, Bancroft Hall with Dahlgren Hall to the left and Macdonough Hall to the right Beyond are the Chapel and the Academic Group

KEEPING THE BOYS PHYSICALLY FIT

Annapolis insures that its students shall possess "a sound mind in a sound body" All forms of athletics are encouraged Here is a contest on the running track

dent, a captain of industry, an admiral, a mechanic, or in the humblest tiller of the soil.

The broad mission of the naval academy has been officially defined as follows:

"To mold the material received into educated gentlemen, thoroughly indoctrinated with honor, uprightness and truth, with practical rather than academic minds, with thorough loyalty to country, with a ground work of educational fundamentals upon which experience afloat may build the finished naval officer, capable of upholding, whenever and wherever may be necessary, the honor of the United States; and withal giving due consideration that healthy minds in healthy bodies are necessities for the fulfillment of the individual missions of the graduates, and that fullest efficiency under this mission can only be attained if, through humane yet firm and just discipline, the graduates carry into the Service respect and admiration for this Academy"

It may be possible for some people to get a fair impression of Annapolis by making a tour of the grounds and buildings within the space of one day, but it would take two, or better, three days, for the visitor to grasp the full significance of this great institution. What time he might have left after doing justice to the wealth of material—architectural, historical, and so forth, in the Academy—he could spend very delightfully and profitably among the stately colonial mansions and in the venerable Court House of Annapolis itself, not failing in the last-named building, to visit the charming old colonial room in which George Washington resigned his commission

Entering by the main avenue gate of the Academy (Maryland Avenue), and turning to the right, the visitor passes the Administration Building and then comes upon the stately pile of the chapel, with its handsome bronze doors and golden dome. Entering the crypt, which will be reminiscent of that of Napoleon, at the Invalides, Paris, he will see the handsome marble sarcophagus of John Paul Jones, his service sword, and his bust by Houdon To the American Ambassador, Horace Porter, a great debt is owing for his successful search, which ended in the finding of the body of Jones in an old, forgotten cemetery in Paris and his bringing it back to the United States, with fitting pomp and ceremony, to its present appropriate resting place in the Academy grounds.

The Imposing Pile of Bancroft Hall

Continuing to the right, one passes the imposing Superintendent's House, and beyond and somewhat back of this he will see a long row of white-brick residences, the quarters of the heads of the Academy. Then, at right angles to these, he will be filled with wonderment by the imposing facade of Bancroft Hall, measuring in over-all length some 640 feet, which, with its two great wings, is capable of housing 2,500 midshipmen As he faces the main entrance he will notice several large buildings which flank Bancroft Hall on either side To the right is Dahlgren Hall, a vast structure, formerly known as the Armory and named after the inventor of the first large-calibre naval guns Both outside and within this hall are objects of deep interest in ordnance and gunnery; and in the gallery upstairs will be found a fascinating collection of naval relics, including a fine collection of photographs of spectacular features of the recent World War The great floor space is large enough for a whole regiment at drill; and it is here that the President of the United States hands out every year the diplomas, after which august ceremony, it is not unusual for some 10,000 people to gather at the "Farewell Ball"

Flanking Bancroft Hall on the other side are the Natatorium, containing the largest indoor tiled pool in the United States, measuring 60 by 100 feet, and beyond that, connected by a colonnade, is the gymnasium, named Macdonough Hall, after the victor in the Battle of Plattsburgh, in the War of 1812 Here he may look on two 24-pounders from the enemy's flagship, *Confiance*, captured at Plattsburgh A notable object is the huge 50-foot model of the *Antietam* under full canvas

Beyond Macdonough Hall is the Seamanship Building, known as Luce Hall, after Rear Admiral Stephen

ON THE PARADE GROUND

No one who visits Annapolis should miss the dress parade of the whole regiment of 2,000 midshipmen on the parade ground

ON THE ANNUAL CRUISE

Long summer cruises at sea form part of the curriculum Here is a navigation class using the sextant

B. Luce, founder of the War College at Newport, R. I. Here are housed the departments and the classrooms of Navigation and Modern Languages.

Bancroft Hall, the central feature of this great group, is a stupendous building, covering 20 acres, containing three miles of corridors, and capable of accommodating 2,500 midshipmen. Entering the central door and passing up the stairway, one enters Memorial Hall, and on the opposite wall notices Perry's battle flag at Lake Erie, with the words of Lawrence upon it, "Don't give up the ship." Memorial Hall is enriched with portraits of naval officers from the earliest down to the present days of our naval history. Passing across the hall, one obtains, through the windows, fine views of Farragut Field, the drill and football grounds, with the harbor and bay in the distance. On the floor below is Recreation Hall, the *midshipmen's lounging room, and below* this are the huge mess hall and kitchen. This mess hall is one of the most spectacular features of the Academy. Imagine a dining room over 523 feet long and 74 feet wide, with the plates, knives, forks, et cetera, set out with exact military precision, for 2,500 midshipmen. Then picture these splendid young men, spick and span, entering the hall and seating themselves with all the precision of a field day inspection. We examined plates, the tines of forks, glasses, chairs, et cetera, and not anywhere was there the slightest sign of dust or dirt. The mess attendants, by the way, are all Filipinos.

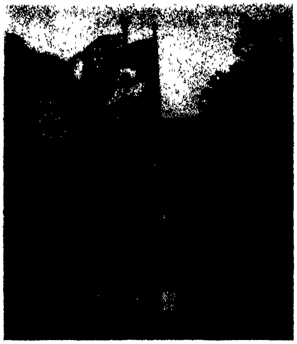
Flanking Luce Hall is Santee Basin, containing the old Spanish cruiser *Mercedes;* and in front of the hall, within Dewey Basin, is the hull of that famous yacht, *America*, looking as smart and clean-lined as when she was launched some 75 years ago. Under shelter in the Basin are the various ship boats in which the midshipmen are trained, and moored along the full length of the Basin is a fine fleet of sailing cutters, in which the midshipmen are regularly trained in boat sailing. At the far end of the green and facing Bancroft Hall are the Academic Buildings, arranged on three sides of a square.

The Academic Group of Buildings

The right wing is Maury Hall, named after that famous naval officer who gave to the world accurate charts of trade winds, ocean currents, and particularly of the Gulf stream. Here are the classrooms in Mathematics and English, and in the basement a small museum with a most interesting collection of Americana which no visitor can afford to miss. The central building, Mahan Hall, named after our foremost naval strategist and historian, contains upstairs the very handsome library, and on the main floor, the auditorium. This building is rich in historical flags, including those from the battle of Manila Bay, a unique collection of Naval Academy flags and some 40 British flags captured in the War of 1812, including those of the *Guerrierre* and the *Java* captured by our most famous ship, *Old Ironsides*, for whose rebuilding contributions are being solicited from the American people, with a request that they be sent to "Save the Constitution" Fund, Charleston Navy Yard, Boston. The left wing of the academic group is called Sampson Hall, after Rear Admiral Sampson, victor at Santiago. Here are the classrooms and the laboratories of the Department of Electrical Engineering and the Department of Physics.

Immediately behind Mahan Hall is Isherwood Hall, named after our foremost marine engineer of the Civil War. To any visitor of an engineering turn of mind, this will prove to be a most fascinating building, and a half day could be spent here to good advantage. The collection both of models and full size marine engine boilers, ships, dry docks, et cetera, is superb.

The Academy students may be regarded as a cross-section of the youth of America. They come from every station of life and from every State in the Union. Rich or poor, the moment they enter the



BEARING THE COLORS

The colors are borne by the company which joins the annual inter-company competition in drill

Academy gates, they fall into the general level of the most perfect democracy ever devised by man. The students are called midshipmen. Five are allowed for each Senator, Representative and Delegate in Congress, and the President appoints five for the District of Columbia and 15 each year from the United States at large. Also, the law authorizes the appointment of 100 enlisted men each year, to be selected by competitive examination. The age at admission must lie between 16 and 20. One midshipman is allowed from Porto Rico, and four are delegated by the Governor-General of the Philippine Islands. The course for midshipmen is four years. During the summer, midshipmen of the first, second and third classes go to sea for about three months. After graduation, the midshipmen are commissioned as ensigns in the Navy. The candidates must be of good moral character, physically sound, well formed and of robust constitution.

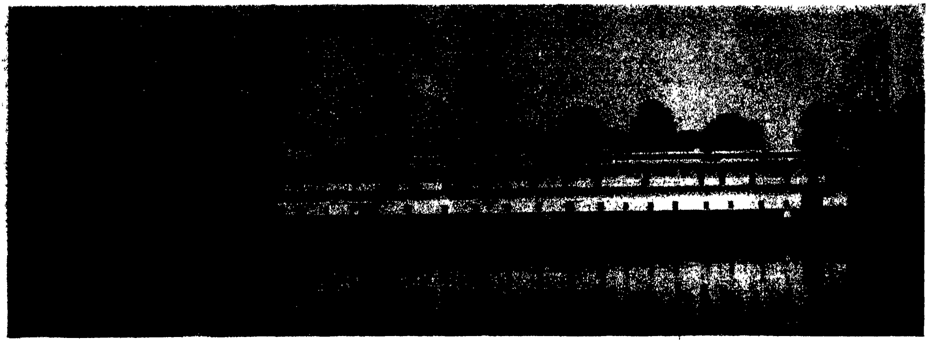
Limitations of space prevent our doing more than merely touch upon the question of physical training. This is, of course, very thorough and includes, naturally, a broad and quite extensive course in the leading sports. The results of robust constitution, fine physique, wholesome living, hard training and strict discipline are shown year by year by the high standing taken by the Navy in the international competitions in which it engages.

WORLD'S CHAMPIONS

The navy crew that won the Olympic Championship for eight-oared crews in 1923

GUN DRILL

Here is a class in ordnance, drilling with a 5-inch, torpedo-defense gun



POWERFUL, DIESEL-ELECTRIC DREDGE *CLACKAMAS*
Length, 236 feet; beam, 50 feet; depth, 12 feet 9 inches; displacement, 2,480 tons; horsepower, 3,400

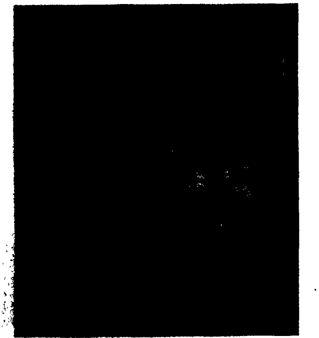
Oil Engine in a New Field

Performance of Powerful Diesel-Electric Dredge, Port of Portland

THE City of Portland, Oregon, situated on the Willamette River, has grown so rapidly that it has become necessary to straighten the channel of the river and to increase the city's dockage facilities for shipping. The dredging plant of the city has recently been augmented by the construction of a steel dredge of great size and unusual strength, which is equipped with Diesel engines and a delivery pipe thirty inches in diameter.

The *Clackamas*, as she is called, was designed by James H. Polhemus, General Manager and Chief Engineer of the Port of Portland, to whom we are indebted for the following particulars. The steel hull, which is 236 feet long by 50 feet beam and 12 feet, 9 inches deep, has a displacement of 2,480 tons at a draft of 7 feet, 9 inches.

Particular attention was paid to the design of the hull to enable it to carry its heavy Diesel engine equipment, and to minimize the damage in case of collision. There are two longitudinal watertight bulkheads, 7 feet inboard, which are intersected by traverse bulkheads and provide six watertight compartments on each side of the hull. The hull space between the longitudinal bulkheads is also divided into six watertight compartments. In addition to these, there is a heavy frame 4 feet, 2 inches deep tied to each panel point of the trusses, extending to the longitudinal bulkheads and the side of the hull, with additional deep frames, 6 feet apart, tied to the longitudinal bulkheads. These bulkheads greatly strengthen the dredge.



STERN VIEW OF THE *CLACKAMAS*
The hinged pockets for the steel spuds, 35 inches in diameter by 80 feet long

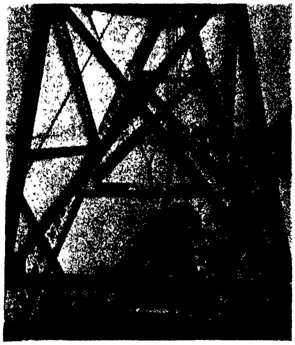
There is a heavy bridge-type double steel truss throughout the full length of the hull, the forward end being extended to form the A frame for the ladder hoist, the spud masts aft being tied into and forming a part of this truss. Forward of the deck-house the top members of the trusses converge, meeting the forward member of the A frame 32 feet forward of the bow. At this location a structural steel frame is formed carrying five sheaves for the ladder hoist tackle, the lower one of which is a quadruple sheave block chained to the digging ladder near the outer end. The spuds are 35 inches in diameter and 80 feet long, constructed of three-quarter inch steel plates rolled into a cylindrical tube, and they are provided with cast-steel conical points at the bottom. The spud wells, in which the spuds slide, consist of heavy, cast-steel, hinged keepers which enable the spuds to be removed.

The main installation consists of two 800-horsepower Diesel engines, stationary type, each directly connected to a 540-kilowatt, direct current generator, and two 900-horsepower, marine-type, Diesel engines, each connected to a 610-kilowatt direct current generator. The combined power is 3,400 brake horsepower, and the consumption is 4¼ barrels of oil per hour (full power). It is possible to stop one unit for repairs and still obtain about 80 percent efficiency with the remaining three. In the electric main drive are two 610-kilowatt 500-volt direct current generators and two 540-kilowatt 500-volt generators with a 50-kilowatt auxiliary generator. The cutter is driven by a 250-horsepower motor. There is a 75-horsepower motor for the forward swing drive hoist, a 45-horsepower motor, each, for the forward ladder hoist and the stern hoist, and a 60-kilowatt generator for lighting and auxiliary power.

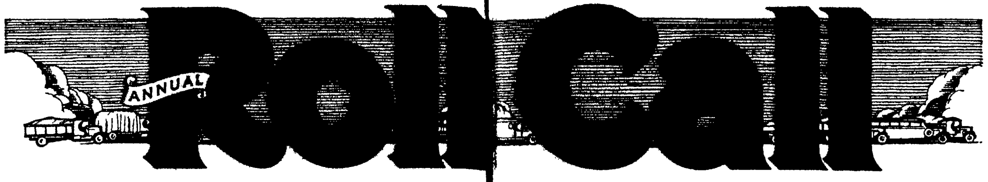
The dredging pump is a high-speed, square, volute-lined centrifugal type pump developed by the Port of Portland, having 30-inch suction and discharge opening.

The main pump motor is a 2,700-horsepower machine directly connected to the pump, and it is the largest of its kind ever built for dredging.

The *Clackamas* has proved its superiority over steam equipment of the same general type. In three calendar days, the new dredge handled 43,700 cubic yards through a discharge pipe 7,590 feet long, moving sand, clay, gravel and sticks with a terminal lift of 29.3 feet. The average discharge for the three days was 797 cubic yards per hour. This was done without the aid of an electric booster. In comparison with the work of the *Clackamas*, the steam turbine dredge *Tualatin* through a discharge line 5,911 feet in length and with a terminal lift of 29.2 feet, an average of 571 cubic yards per hour; but the latter dredge required the assistance of an electric booster.



VIEW LOOKING FORWARD FROM BOW
The forward end of a heavy steel truss forms the A frame for the ladder hoist



WHITE FLEETS of TEN or MORE

The annual White Roll Call again! It is the industry's most convincing performance document.... Greater fleets.... Greater total of fleets.... Greater diversification of fleets.... Greater evidence of the consistently increasing earning power of White Trucks and White Busses—all models, in all lines of business, everywhere.

This year's Roll Call shows 961 of the country's foremost owners operating 35,755 Whites *in fleets of ten or more* .... 124 more owners than last year .... 4,662 more Whites.

Imposing as this total is—35,755 Whites in Roll Call fleets—it represents less than half the Whites in service. Tens of thousands of additional owners operate fleets of less than ten, or single Whites. There are more Whites in service than trucks or busses of any other high-grade make.

Each line in this record represents a business success. Great, growing institutions invest millions in additional Whites year after year. They don't guess. They know motor transportation.... They know they get the *most money-earning miles* from Whites.

This record is published every year. The building up of most of the fleets goes back over five, ten—in some cases fifteen and sixteen years. Every year has brought tremendous increases.

The safest, soundest guide to your own selection of a motor truck or a motor bus is facts. The Roll Call is facts—an astounding collection of them.

No other truck or bus manufacturer has ever published such a volume of evidence of uninterrupted, profit-building service. No other manufacturer can.

* * * * *

Let us send you the complete White Roll Call booklet, tracing the building of these great fleets year by year. Write The White Company, Cleveland, or request it of the branch office or dealer near you.

There is a White model for every transportation need White Truck chassis, $2,150 to $5,100; Bus chassis, $4,250 and $5,350; f. o. b. Cleveland. Terms.

	Whites Owned
Abbotts Alderney Dairies, Inc.	55
Abraham & Straus	67
Acme Cash Stores	18
J N Adam & Company	41
Advance Transfer Company	14
Aguas Blancas Nitrate Company	11
City of Akron, Ohio	26
Akron Pure Milk Company	18
Alabama Coca-Cola Bottling Co	18
Alabam's Freight Service	11
Albers Brothers Milling Co.	16
Allegheny County	13
Alms & Doepke Company	10
B Altman & Company	94
American Agricultural Chem Co.	28
American Bakery Company	15
American Can Company	84
American Chain Company	13
American Fruit Growers, Inc.	10
American Gas & Electric Co	20
American Ice Company	28
American Motor Tours Co.	15
American News Company	30
American Oil Company	12
American Petroleum Company	27
*American Power & Light Co	42
American Public Service Co	16
American Railway Express Co	585
American Red Cross Society	31
American Reduction Company	11
American Relief Admin (Russia)	21
American Steel & Wire Co	37
American Stores Company	136
American Tobacco Company	11
*American Water Wks & Elec Co	16
American Woolen Company	31
A. L. Ammen Trans Co	48
*Anaconda Copper Mining Co	15
Anderson Brothers	17
Anglo-Mexican Pet. Co , Ltd	10
Anheuser-Busch, Inc.	18
State of Arizona	12
Arlington Mills	18
Armour & Company	441
J. H. Ashdown Hardware Co., Ltd	10
*Associated Bell Telephone Co	1420
*Associated Dry Goods Corp.	11
Associated Gas & Electric Co	11
Athens Coca-Cola Bottling Co	23
City of Atlanta	41
Atlanta Baggage & Cab Company	22
Atlanta Chero-Cola Bottling Co	15
Atlanta Coca-Cola Bottling Co	23
Atlantic Ice & Coal Corp	68
Atlantic Refining Company	545
Atlas Powder Company	23
Andrew Augustine	11
Austin, Nichols & Company	33
Ayer & McKinney	11
Bacon Coal Company	13
The Bailey Company	39
Baker Evans Ice Cream Co.	10
Bakersfield-Los Ang Fast Freight	24
City of Baltimore	46
L. Bamberger & Company	81
Bang Supply Company	16
Banner Grocers' Baking Company	14
N Bentivoglio & Sons	11
Bardsleys Motors, Ltd	27
Barker Brothers, Inc	18
*Barnsdall Corporation	15
The Barrett Company	19
Beaver Valley Service Company	24
B C Motor Transportation Ltd	20
Beechnut Packing Company	16
Bekins Van & Storage Company	23
Belcher Asphalt Paving Company	10
Benguet Auto Line	10
Bernheimer-Leader Stores Inc	16
Berwick Cake Company	11
Bessemer Taxi Company	19
Best & Company	20
William Bingham Company	27
Bingham Stage Line	11
Samuel Bingham's Sons Mfg Co	12
Birmingham Chero-Cola Bot Co	34
City of Birmingham	26
Bishop & Company	11
H L Black & Son	10
Block & Kuhl Company	16
Frank E Block Company	11
Bloomingdale Brothers	41
Blue Ridge Transportation Co	14
Bluff City Delivery Company	11
Boggs & Buhl, Inc	27
The H C Bohack Company	17
The Borden Company	46
City of Boston	44
Boston Coca-Cola Bottling Co	10
Boston Elevated Railway Co.	120
Boston & Maine Railroad	15
Botsum Brothers Company	15
Bourne-Fuller Company	14
George H. Bowman Company	10
Bowman Dairy Company	31
Brandies Stores	10
Bradford Baking Company	47
The Brandt Company	43
J. W Brannon Sand & Gravel Co	14
Braun Lumber Company	10
John Breuner Company	14
Brewster Transport Co. Ltd	14
Bridgeman & Russell Company	24
Brink's Express	14
Broadway Department Store	31
Bronx Provision Corp of New York	10
Brooklyn Daily Eagle	18
Brooks Oil Company	12
Bry-Block Mercantile Company	18
Buckeye Pipe Line Company	30
Buenos Aires Post Office Dept	22
Bullock's	23
W N Burdine Sons	13
P. H. Butler Company	39
Byrne Bros Construction Co	42
Cable Draper Baking Co	10
State of California	65
California Baking Company	21
California Nevada Stage Co	24
California Packing Corporation	41
California Petroleum Company	27
California Transit Company	39
California Truck Company	21
L. H Callan	15
J. Calvert's Sons	21
William Cameron Company, Inc	16
R. O Campbell Coal Company	16
The Campbell Baking Company	33
Canfield Oil Company	25
Canton Provision Company	13
Canton Storage & Transfer Co	10
Capitol Garage	10
Carbon Coal Company	13
R. E Carey Company	12
Carnegie Steel Company	10
Carolina Power & Light Co	18
Carolina Public Service Co	13
J. B. Carr Biscuit Company	11
Carroll Bros Truck Service	24
Carstens Packing Company	11
Carter Oil Company	18
Casper Motor Bus Line	16
Central African Transp Co	11
Central Torpedo Company	12
Chandler & Rudd Company	11
Chase Metal Works	21
Cheek-Neal Coffee Company	19
Chero-Cola Bottling Companies	119
The Chero-Cola Company	87
City of Chicago	160
Chicago Amer. & Herald-Exam	44
Chicago Fire Brick Company	21
Chicago Fire Insurance Board	11
Chicago, N. Shore & Mil. R R Co.	31
Chicago Surface Lines	13
Chicago Towel Company	22
Chile Exploration Company	12
H. B. Church Truck Service Co.	16
Cincinnati Coca-Cola Bot. Co	11
Cincinnati Motor Terminals Co	19
Cincinnati Traction Company	10
*Cities Service Company	121
City Baking Company	18
City Ice Company (Kansas City)	12
City Ice & Fuel Co (Cincinnati).	22
City Ice & Fuel Co (Cleveland)	19
Clearing House Par Deliv. Co	13
City of Cleveland	217
Cleve-Ashta-Conneaut Bus Co	38
Cleve Bldrs Sup. & Brick Co.	93
The Cleveland Cartage Co	22
Cleveland Elec. Illuminating Co.	72
Cleve-Elyria-Toledo Bus Co.	12
The Cleveland Press	25
Cleveland Provision Company	35
Cleveland Railway Company	64
Cleveland Trans & Cartage Co	37
Cleveland Trinidad Paving Co	14
Cleveland & Sandusky Brew Co	32
Cloverlands Dairy Products Co	12
Cloverleaf Creamery Co	10
Clover Meadow Creamery Co	12
*Coca-Cola Bottling Companies	382
The Coca-Cola Company	104
The Coca-Cola Co Ltd (Canada)	70
Coca-Cola Bot. Wks. (Nashville)	11
W J Coldiron	10
J C Coleman & Son	12
Coleman & Clark	10
James E. Colliflower & Co	10
Collins Hauling Company	22
Colonial Ice Cream Company	27
Colorado Coca-Cola Bottling Co	11
Columbia Coca-Cola Bot Co	14
Columbia Ice & Ice Cream Co	18
Columbia Stages	32
L H Colvin	10
Comar Oil Company	22
R H Comey Company	11
Comfort Coach Company Ltd	12
Commercial Oil Company	10
Commercial Transfer Company	14
Commonwealth Fuel Co Inc	68
Commonwealth Pr., Ry & Lt Co.	18
State of Connecticut	47
The Connecticut Company	79
Connecticut Motor Transp Co	16
Connecticut Pie Company	10
Conrad-Baisch-Kroehle Co	12
Consolidated Companies	33
Consolidated Ice Company	11
Consolidated Motor Freight Lines	16
Consolidated Rendering Co	44
Consumers Baking Company	20
*Consumers Bread Company	30
Consumers Dairy Company	23
Consumers Pie & Baking Co	18
Continent Baking & Milling Co	21
*Continental Baking Corp	37
Continental Oil Company	140
Copper Range Motor Bus Co	11
Coral Gables Corporation	47
Cottage Creamery Company	13
Walter J Cox Company, Inc	14
Crane Company	31
Crescent Forward & Transp Co	19
Cuban Government	20
Cudahy Packing Company	38
John T Cunningham	42
Cushman Sons, Inc	12
Cuyahoga County (Ohio)	17
Dahl-Campbell Grocery Co	17
Dannemiller Grocery Company	10
Darling & Company	48
Thomas D'Attilio	20
Davies Supply Company	12
Davis Construction Company	18
Davison Cartage Company	12
The Dayton Company	13
Daytona Shores	10
De Haven Ice Cream Company	10
City and County of Denver	11
Denver Cab Company	40
Louis Des Cognets	13
Dill & Collins Company	11
Dixie Construction Company	73
Dominion Bridge Company, Ltd	11
Drake Brothers	26
Drake Lumber Yards Inc	16
Driscoll Trucking Company	22
Duke Power Company	13
E I Dupont De Nemours Pdr Co	16
Eagle Bottling Works	11
East Ohio Gas Company	20
East Side Mill & Lumber Co	16
Eastern Torpedo Company	26
Eastman Kodak Company	13
Thomas W Easton's Sons	21
T Eaton Company, Ltd	42
Eckenroth Sales Company	14
Abraham Eisenberg Co , Inc	11
Ejercito de Chile (Army)	15
*Electric Bond & Share Co	80
Eleto Company	88
G T. Elliott	12
Emerick Motor Bus Company	10
Emerson & Morgan Coal Co Inc	10
Empire Gas & Fuel Company	19
Ernst Fuel & Supply Company	12
A. J Evans	21
The Fair	12
Fair Haven Coal Company	10
Fairmont Creamery Company	65
Farrar-Carlin & Granfield	10
Fayette Baking Company	15
Wm Filene's Sons Company	16
Firestone Tire & Rubber Co	13
Fischer Baking Company	21
Fischer Lime & Cement Co	11
The Fleischmann Company	28
Flesher Transfer Company	10
State of Florida	23
Florida Coca-Cola Bottling Co	20
Florida Motors Line Inc	27
Fly & Hobson Company	14
C H Foley	20
Foster & Kleiser Inc	24
Frank & Seder	40
Franklin Ice Cream Company	31
Harry V Franks	23
Frederick & Nelson, Inc	23
William Freihofer Baking Co	54
Frischkorn Florida Company	10
Fujiya Hotel Garage	11
Fuller Cleaning Company	16
W P. Fuller & Company	32
Fullington Auto Bus Company	13
County of Fulton, Ga	11
G H P. Cigar Company	11
Frank Gaffney	15
Galena Signal Oil Company	15
Garfield-Passaic Transit Co	18
Geilfuss Bakery	12
General Baking Company	241
*General Electric Company	43
General Fire Extinguisher Co	16
General Gas & Electric Corp	18
*General Ice Cream Company	10
General Linen Sup & Ldry Co	28
General Petroleum Corporation	108
General Stores Corporation	12
Georgia Railway & Power Co	76
Gerkins Oil Company	13
Gilmore Oil Company	13
Gimbel Brothers, Inc. (Milwaukee)	13
Gimbel Brothers, Inc. (N Y)	92
Gimbel Brothers, Inc (Phila)	91
Glacier Park Transportation Co	61
Globe Bottling & Sales Co	11
Globe Grain & Milling Co.	28
City of Gloucester	15
Gloucester Auto Bus Company	18
Adolf Gobel, Inc	50
Goeringer Construction Co	11
Goff-Kirby Company	18
Golden Sheaf-Romer Baking Co	19
Golden State Auto Tours Corp	12
Goldenrod Ice Cream Co	27
J. Goldsmith & Sons Company	11
B. F Goodrich Company	10
Goodyear Tire & Rubber Co	22
Gordon & Harrison	10
Grasselli Chemical Company	15
Gray Construction Company	31
Grays Harbor R., L. & P Co	15
The Great Atlan & Pac. Tea Co	17
Great Northern Paper Co	29
Great Southern Refining Co	11
Greenfield Elec. L & P Co	20
Greif Brothers Cooperage Co	43
Gridley Dairy Company	18
Gulf Coast Motor Lines	10
Gulf Pipe Line Company	14
Gulf Production Company	16
Gulf Refining Company	1929
Gypsy Oil Company	37
H. F Haden	13
Hadley Furniture & Carpet Co	28
Hahne & Company	49
Halle Brothers Company	21
Hammond Lumber Company	12
W T. Hardison & Company	11
The Hardware & Supply Co.	10
Harman-Hull	13
Hartford Electric Light Co.	13
Hartman Furniture & Carpet Co	22
Fred Harvey	31
C. F Hathaway & Son	15
Hauser Packing Company	17
Haverty Furniture Company	30
Hawaii County, T H	10
Hawaiian Pineapple Co , Ltd	29
*The Hecht Company	36
H. J Heinz Company	83
Heissler & Junge Company	18
Hercules Powder Company	23
Peter Herkner Trucking Co.	12
Hershey Creamery Company	14
Hess Brothers	11
Heywood-Wakefield Company	11
Hialeah-Allapatta Bus Line	18
The Higbee Company	23
Hildebrandt Provision Co.	20
F. H. Hill Company	12
H. G Hill Grocery Company	22
Hitchner Biscuit Company	11
Hochschild Kohn & Company	27
H B. Hole	17
Holland Bread Company	73
*Hollywood Land & Water Co (Fla)	90
Hong Kong Hotel Co., Ltd	11
Honolulu Const. & Dray Co , Ltd.	15
H. P. Hood & Son	19
Hope Natural Gas Company	27
Joseph Horne Company	50
Houston Lighting & Power Co	12
Huasteca Petroleum Company	38
The Hub (Baltimore)	11
J. L. Hudson Company	58
Hudson's Bay Company	26
Hughes-Curry Packing Company	11
H. B Hughes Truck Company	21
Humble Oil & Refining Co	60
Hutsler Brothers Company	10
Ice Delivery Corp. (Norfolk)	11
State of Idaho	30
State of Illinois	61
Illinois Power & Light Corp	23
Imperial Ice Cream Company	23
Imperial Oil, Ltd.	121
Independent Brewing Co of Pitts	82
Ind School Districts (Minn)	30
Independent Torpedo Company	21
Independent Towel Supply Co	31
Indian Automobile Co., Ltd.	13
Indian Refining Company	11
State of Indiana	43
International Petroleum Co	22
International Petroleum Co , Ltd	48
Interstate Public Service Co	18
Interstate Wholesale Grocers, Inc	27
Interurban Transportation Co	11
Iowa State Highway Com	32
Iron City Sand Company	13
Iron Range Transportation Co.	15
County of Jackson (Missouri)	14
A. Jackson & Sons	10
Jackson Brewing Company	10
Jahncke Service, Inc	18
Oswald Jaeger Baking Company	10
Jefferson County Boards (Ala.)	81
Jessup & Antrim Ice Cream Co.	11
Johnson Bus Lines, Inc	10
Johnson Oil Refining Co.	10
Jones Store Company	23
Julian Petroleum Corporation	22
Jump Housewrecking Company	14
S. Kann Son's Company	30
Kansas City Power & Light Co	12
Kansas Gas & Electric Company	26
Kaufmann & Baer Company	40
Kaiser Transportation Co , Inc	14
Kellogg & Ferner	13
Kennicott-Patterson Transfer Co.	11
C. D. Kenny Company	66
J. Kenny Transfer Company	18
State of Kentucky	29
Kern County (California)	32
King County (Washington)	24
Kingan & Company	57
Kinney & Levan Company	11
The Kirk Company	12
B. B. & R. Knight, Inc.	12
E. H. Koester Bakery	20
Charles Kuppinger	10
Lackawanna Laundry Company	17
Laclede Gas Light Company	13
Lake County (Indiana)	21
J. M. Landers	13
Lansburg & Bro	15
Lantro Nitrate C ny	10
La Salle & Koch pany	13
Jacob Laub Bak	27
Laundry Truck mpany	10
C. Lewis Lavine	24
A. Leath & Com	10
J. William Lee &	13
Fred T. Ley & Co ny	20
Leyte Land Tran tion Co.	30
Liberty Baking C y	31
Lightning Delive mpany	10
Lilly White Gas ompany	31
Lincoln Fireproo age Co	11
Lind Transfer Co y	11
Liquid Carbonic any	10
Lit Brothers, Inc	50
Livingston Bakin pany	13
Frederick Loeser mpany	30
Loft, Inc.	15
Log Cabin Bakin pany	13
Long-Bell Lumb mpany	31
Long's Transfer any	10
J P Loomis Co upply Co	22
Loose-Wiles Bisc ompany	86
City of Los Ang	23
County of Los A	37
Los Angeles Brew ompany	34
Los Angeles Cre Company	27
Los Angeles Gas Corp	91
Los Angeles Ice & Stor Co	30
Los Angeles Rail orp	17
Louisiana Coca-C ottling Co	10
Louisville Railwa pany	17
City of Lowell (M	13
Alexander Lurie	76
Lutter Brick Co	15
M. L. W Truck C ny	13
R. H. Macy & Co y	11
Magnolia Petrole mpany	175
Mahoney Lumbe	10
Mandel Brothers	48
Manhattan Oil C ny	13
City of Manila	15
Marin Transport Company	11
Maritima de Con rans Cia	11
Marland Refinin pany	63
Maryland State Com	88
State of Massach	18
Massachusetts B Company	94
Massachusetts L Co	12
George Matthew	10
May, Stern & Co y	12
The May Compa eveland)	59
The May Compa s Angeles)	30
McCreery & Co	19
McCutcheon-Ch Company	14
McGowan Broth mpany	12
G. M. McKelve ny	24
McMahon Trans ion Co	22
McQuesten &	11
L. G. Meed	11
Wm. J. Meehan her	11
Peter Mehlos	10
Memphis Power & Light Co	10
*Mercantile Stores Company	49
Merchants' Transfer Company	22
Merkel Brothers, Inc	16
Mesaba Transportation Co	20
Metropolitan Coal Company	30
Metropolitan Distributors, Inc	32
Metropolitan News Company	15
Metropolitan Tobacco Company	12
Mexican Gulf Oil Company	26
Mexican Pet. Co., Ltd. (Dela)	29
Mexico, D F —Ayuntamiento	13
Louis Meyer Company	28
Miami Herald	10
A. Michalske (G Worthington Co)	20
Middlesex & Boston Street R. R	33
*Middle West Utilities Corp	26
Milk Dealers Bottle Exchange	14
J. E. Miller	24
Olga Miller Trucking Company	20
Miller-Becker Company	12
P. Millitron	10
Milwaukee Elec. Ry. & L Co	67
State of Minnesota	41
Missouri-Illinois Stores Co	12
Missouri Portland Cement Co	12
T V. Monaghan	83
J. H. Montague & Company	10
Montgomery County Bds. (Ala)	12
Montreal Tramways Company	13
Moores & Ross Milk Company	10
Henry Morgan & Company, Ltd.	16
K. E. & A. K. Morgan	39
Morgan Hill Paving Co	11
Motor Bus Company	10
Motor Transit Company	117
The Mozie Company.	10
Murphy Transfer Co , Inc	30
Mutual Creamery Company	15
H. E Naats Company	20
A. I. Namm & Son	68
Nacional Constructura, S A , Cia	14
Nafziger Baking Company	26
City of Nashville	17
National Biscuit Company	193
National Board Fire Underwriters	16
National Breweries, Ltd	11
National Casket Company	33
*National Dairy Products Corp	19
National Ice & Cold Storage Co.	27
National Ice Cream Company	11
National Lamp Works (G E)	10
National Lead Company	16
National Oil Company	31
National Refining Company	73
Neal Fireproof Storage Co	14
N. O. Nelson Mfg. Company	13
State of Nevada	17
Nevada-California Electric Corp	20
Province of New Brunswick	19
New England Bakery	10
New England Furn. & Carpet Co.	10
State of New Hampshire	13
New England Public Service Co	21
City of New Orleans	74
New Orleans Public Service, Inc	56
City of New York	856
State of New York	42
New York American & Journal	43
N. Y. Board of Fire Underwriters	21
*New York Central Railroad Co.	22
N Y Linen Sup. & Laundry Co	30
New York State Railways	45
City of Newark	13
Newark Milk & Cream Co	12
Newman Brothers	10
W. J Newman Company	14
Noonan Bldg. Material Co , Inc	19
Norsk Trafik A/S	10
*North American Co	17
State of North Carolina	135
North Shore Food Products Co	12
Northern Ohio Trac & L Co	107
Northern States Power Co.	24
*Northland Transportation Co	43
Province of Nova Scotia	26
Rogelio C Novo	13
Nu-Grape Bottling Company	28
State of Ohio	79
Ohio Oil Company	48
Oil Fields Transport Company	10
Oilfield Trucking Company	11
State of Oklahoma	13
Oklahoma Gas & Electric Co	18
Oliver Iron Mining Company	11
Olsen & Roach	10
M. O'Neil Company	13
Onondaga County (New York)	14
Oppenheim, Collins & Co.	45
Orange Crush Bottling Companies	14
State of Oregon	19
Original Stage Line	12
The Outlet Company	15
Ovington Brothers Company	15
Ozark Pipe Line Company	29
Pacific Baking Company	34
Pacific Electric Railway Co	80
Pacific Fruit & Produce Co.	62
Pacific Gas & Electric Co	37
Pacific Mills	25
Pacific Northwest Traction Co	13
Palais Royal	17
Pan American Petroleum Co	45
*Pan American Pet & Trans Co	78
Park Auto Transportation Co	21
Park & Tilford	13
Parker Brothers, Ltd	24
Frank Parmalee Company	19
Paterson Brewing & Malt Co	10
Paul's Bake Shop	11
Pechter Baking Company	16
D Pender Grocery Company	13
Peninsula Rapid Transit Co	28
State of Pennsylvania	21
Pennsylvania Edison Company	37
Pennsylvania Electric Corp	10
Pennsylvania-Ohio Electric Co.	52
People's Gas Light & Coke Co	24
Perrett & Glenney	12
D. Peters	19
Petroleum Heat & Power Co	12
Phelps-Dodge Corporation	10
City of Philadelphia	11
Philadelphia Toilet & Laund Co	14
Philippine Government	53
Phoenix Utility Company	33
M H Pickering Company	10
*Pie Bakeries of America, Inc	16
Pierce Petroleum Corporation	210
*Piggly Wiggly Stores	38
Pike's Peak Auto Highway Co	17
Pilsener Brewing Company	18
Pioneer Sand & Gravel Co	11
Pioneer Tourist Coaches Ltd	10
Pioneer Truck & Transfer Co	17
Pittman Construction Co	10
Pittsburgh Gage & Supply Co	14
Pittsburgh Plate Glass Co	32
Pittsburgh Press	20
L. S. Plaut & Company, Inc	16
H & S. Pogue Company	19
Portland Sebago Ice Co	15
Postal Telegraph Cable Co	16
Potts & Callahan	11
Powers Mercantile Company	21
*Prairie Oil & Gas Company	45
Prairie Pipe Line Company	67
Producers & Refiners Corp	12
City of Providence	10
Providence Journal Company	11
Public Service Co of Colorado	26
*Public Service Corp of N J	34
Public Service Electric Co	90
Public Service Gas Co	12
Public Service Production Co	26
Public Service Transp Co	108
Puget Sound Electric Railway	13
*Puget Sound Pr & Lt Co	27
*Pure Oil Company	30
*Purity Bakeries, Inc	12
Purity Baking Company	34
Purcell Brothers	14
Puyallup-Tacoma Transit Co.	23
Quaker City Cab Company	150
Queens Bus Line Company	55
City of Quincy	10
B. A. Railton Company.	10
Rainier National Park Co	29
Rand Kardex Bureau	12
Red Rock Company	18
T N Reed Grocery Company	10
Republic Struc. Iron Works Co	13
A G Rhodes & Sons	10
Frank G Richards	22
Richfield Oil Company	91
Richmond Rapid Transit Co	20
Ridgewood Pie Baking Company	10
Rieck-McJunkin Dairy Co	88
City of Rio de Janeiro	10
Rio Grande Oil Company	43
Ritchie Grocer Company	12
Roberts Sanitary Dairy	12
Rochester Gas & Electric Co	55
Rochester Ice Cream Co	10
Rocky Mount Parks Transp Co	95
L W Rogers Company	21
Rome Coca-Cola Bottling Co.	11
The Rosenbaum Company	50
B Rosenberg Company	21
*The Royal Dutch Company	45
*Roxana Petroleum Corporation	382
Fred Rusch	27
George Rushton Baking Co	11
J P Ryan	12
Saginaw Transit Company	10
City of St Louis	20
St. Louis Bus Company	34
City of St. Paul	19
St Regis Paper Company	10
Saks & Company	45
Salt Lake Transportation Co	26
San Antonio Public Service Co	10
San Bernardino County (Calif)	12
San Diego Cons G & E Corp	24
San Francisco (City-County)	52
San Francisco Municipal Ry	12
San Joaquin Baking Company	29
San Joaquin L & P Corp	32
A Sander Packing Company	10
Sanger Brothers	12
Sanitary Grocery Company	12
Santa Ana Commercial Co	16
S R-P & S Auto Stage Co	15
Santo Domingo Pub Wks Dept	35
John E Schaible	20
Schmidt & Zeigler, Ltd	10
Henry Schultz	11
Schulze Baking Company	52
S & E Motor Hire	26
George Scofield Company	17
Scott Transportation Company	17
E H Scott Transportation Co	12
Scruggs-Vanderv't-BarneyD G Co	11
City of Seattle	22
Seattle Garbage & Hauling Co	10
H. O Seiffert Company	13
Seminole Lumber & Trading Co	18
Semon Ice Cream Corp	10
Seminole Sightseeing Service	14
Seven Baker Brothers	40
Shaeffer-Black Company	18
Shaffer Oil & Refining Co	50
Sharpless-Hendler Ice Cream Co	28
J B Shaw	10
Dennis Sheen Transfer Co	24
Shell Oil Company of California	185
Shell Company of Canada, Ltd.	11
Shepard Norwell Company	13
Sherman Clay & Company	16
The John Shillito Company	15
Shults Bread Company	18
Sieloff Packing Company	15
Franklin Simon & Company	27
Sinclair Consolidated Oil Corp	21
Sioux Falls Traction System	12
Sita Drayage Company	11
Skelly Oil Company	21
Skellet Transfer Company	11
Louis Slacum	10
W & J. Sloane	36
A W Smith	11
Smith Baking Company	13
Sonoma County (Calif)	14
State of South Carolina	28
State of South Dakota	10
Southeastern Express Company	176
Southern Dairies, Inc.	54
Southern Dray Company	10
Southern Mill & Bungalow Co	14
Southern Oil Corporation	16
*Southern Pacific Company	13
Southern Utilities Company	20
W P Southworth Company	15
J Spang Baking Company	20
R. Z Spaulding Company Inc	13
Spear & Company	22
Sperry Flour Company	16
Spokane Portland & Seattle R R	30
City of Springfield (Mass)	13
William Stacy Storage Co	10
Stadler Products Company	12
Otto Stahl, Inc	30
*Standard Bakeries Corporation	15
Standard Brewing Company	12
*Standard Gas & Electric Co	10
Standard Grocery Company	10
Standard Oil Company of Brazil	13
Standard Oil Company of Calif	276
*Standard Oil Company of Ind	242
Standard Oil Company of Ky	495
Standard Oil Company of La	136
Standard Oil Company of Neb	29
*Standard Oil Company of N J	285
Standard Oil Company of N Y	1032
Standard Oil Company of Ohio	162
Standard Pipe Line Company	19
Standard Sanitary Mfg Co	58
State Construction Company	14
C P Steinheiser Company	10
Sterchi Brothers	24
Sterling & Welch Company	21
Stern Brothers	36
John Sternecker	72
Steubenville Coal and Mining Co	13
F H Stewart	26
Stewart & Company	22
M I Stewart & Company Inc	20
Stoll Oil Refining Company	22
*Stone & Webster Interests	74
Strawbridge & Clothier	55
Stroehmann Baking Company	20
Stryker Trans & Cont Co	12
Summerfield Company	15
The Sun Oil Company	87
Superior Transfer Company	26
Syracuse Lighting Company	24
Tacoma Bottling Works	20
Taylor Bros & Paquet Co	14
Wm Taylor, Son & Company	33
Teche Transfer Company	33
*Telling-Belle Vernon Company	94
State of Tennessee	12
Terre Haute Brewing Company	10
Tennessee Electric Power Co	12
State of Texas	84
The Texas Company	156
Texas Power & Light Company	17
Textile Machine Works	10
Theurer-Norton Provision Co	18
Thomas Bennett & Hunter	21
Tidal Oil Company	22
Tide Water Oil Sales Corp	68
City of Tokyo (Japan)	19
Tokyo Shigai Tidosha Co	65
Toledo Edison Company	13
City of Toronto, Ont (Canada)	12
Transcontinental Oil Co	37
Tranvais de Mexico Cia	12
Tribune Pub Co (Oakland)	10
John Turner	10
E Arthur Tutein Inc	15
Twin City Motor Bus Company	41
Union Auto Transportation Co	19
Union Electric L & P Co	11
Union Ice Company	41
Union Gas & Electric Co	62
Union Oil Co of California	780
Union Pacific System	11
Union Transfer Co (Fremont)	10
Union Transfer Co (Philadelphia)	18
Union Wholesale Lumber Co	12
Uniontown Baking Company	10
United Automobile Services, Ltd.	40
United Drug Company	11
United Electric Light Company	13
United Electric Railways Co	34
*United Gas Imp Co Interests	68
United Natural Gas Company	13
United Railways & Electric Co	55
United Shoe Machinery Corp	17
United States Bakery	27
United States P O Dept	664
United States Rubber Company	27
*United States Steel Corp Int	30
United Transportation Co	10
Updike Lumber & Coal Company	13
State of Utah	11
Utica Gas & Electric Co	28
Vacuum Oil Company	47
A Valdez y Cia	13
State of Virginia	61
Viscose Company	11
Vogt Brothers, Inc	11
F. G. Vogt & Sons, Inc	12
Wachter Transfer Company	14
Waite Phillips Company	15
Walgreen Drug Company	12
John Wanamaker	98
Ward Baking Corporation	38
Warner Sugar Refining Co	17
F B Washburn & Co	10
Washington Bakeries Corp	43
Washington Ry & Electric Co	22
Wayne County (Michigan)	10
Weber Baking Company	10
Weicker Transfer & Storage Co	14
Weil-McLain Company	10
Raphael Weill & Company	20
Percy Wenham	33
Gilbert H West	10
West Kentucky Coal Co	12
West Penn System	51
West India Oil Company	34
State of West Virginia	22
Western Contractors Inc	10
Western Electric Company	40
Western Maryland Dairy Inc	13
Western Meat Company	27
Western Motor Transfer Co	24
Westinghouse Elec & Mfg Co	20
Wheeling Steel Corporation	26
*J G White & Company	10
R H White Company	10
White Transfer & Storage Co	13
White Transit Company Inc	60
White Transit Company Ltd	13
Whiting-Mead Commercial Co	24
W A Wieboldt Company	25
Willard's Chocolates Ltd	14
Willett Teaming Company	14
Wilshire Oil Company	16
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Winona Oil Company	14
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Wise Brothers	25
Wofford Oil Company	38
Wood River & Alton Bus Lines	12
G B Woods Cartage, Ltd	21
Woodward & Lothrop	23
Woolner Brewing Company	12
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C H Yeager Company	12
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Youngstown Sheet & Tube Co	10
Ypsilanti Reed Furniture Co	11
Zamboanga Transportation Co	18
Zellerbach Paper Company	15
Zettelmeyer Coal Company	27
Zions Co-operative Merc Inst	14
	35,755

*Exclusive of subsidiary or affiliated companies individually listed

WHITE TRUCKS

AND WHITE BUSSES

THE WHITE COMPANY
CLEVELAND

FRAMING UP OUTER SHELL AND HUGE PISTON OF GAS HOLDER

In the standard type, the outer telescopic shell rises and falls as the holder fills and empties. In this new type the shell is rigid and the piston has vertical movement

Something New in Gas Holders

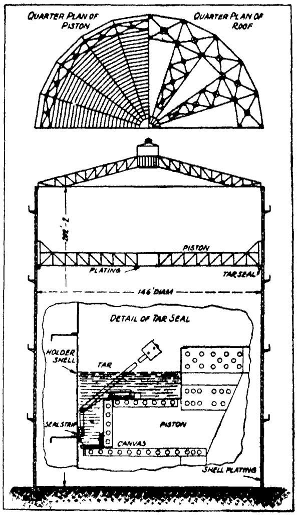
Details of a Waterless, Non-telescopic Gas Holder at Michigan City, Indiana

HITHERTO those huge constructions known as gas holders, have been of the telescopic type They consist of several cylindrical sections of diminishing sizes, which move down, one within the other, as the gas holder is emptied or which lift, section above section, to the full height as the holder fills with gas. The escape of gas at the bottom of each section is prevented by a water seal.

Non-telescoping Gas Holder

The gas holder shown here consists of an outer polygonal shell, within which is a huge polygonal piston which rises or falls as the gasometer is filled or emptied The particular gas holder shown in our illustration was built at Michigan City, Indiana, and was the first of the new type to be built in America, although it was preceded by others which were built in Germany, where the design originated. The outer polygonal shell is built of horizontal steel plates whose upper and lower edges are bent over through 90 degrees to form flanges by which the plates are riveted together and which, moreover, serve to give stiffness and keep the interior of each side of the holder in a true plane surface The piston, as shown in our photograph and drawing, is built up of steel trusses which radiate symmetrically from the center, and its whole area is covered with plate-steel, carefully riveted to render the whole piston gas-tight. To guide the piston in its vertical travel, it carries a series of pairs of wheels which are arranged one above and one below the piston and are mounted in a series of brackets, one at each angle of the polygon.

Outside of the general novelty of this gas holder, the most interesting detail, perhaps is the way in which the piston is sealed against the escape of gas between itself and the abutting walls This is done by means of an outer seal, which consists of a flat rubbing plate, turned up slightly on the edges to enable it to glide smoothly as the piston moves This plate is kept in contact with the side of the holder by weighted levers, as shown in the detailed drawing, and the rubbing plate is thin enough to accommodate itself to any slight irregularities in the surface against which it presses and moves. A gas-tight joint between this rubbing plate and the piston is made by canvas which is attached to the back of the plate and carried over to the side of the piston, as shown in our sketch. The canvas is not subject to friction or any kind of stress, and is durable A little circumferential tank or trough containing the rubbing plate and canvas is filled with tar, as shown



DETAILS OF GAS HOLDER

These sectional views show the gas holder shell of uniform diameter, the trussed piston, which conforms to the shell; plans of the piston and roof, and the ingenious tar seal

Such tar as may leak by the rubbing strip runs down into a circumferential reservoir at the bottom of the holder, and the system is so arranged that when the tar level reaches a certain point, a switch will be thrown and the pump will carry the oil back to the tar seal on the circumference of the piston.

The piston is prevented from overrunning and striking the roof of the holder by the provision of several holes through the top of the holder by which the gas can escape. The holder at its top finishes in a series of glass windows through which the piston may be examined.

A Radical Design

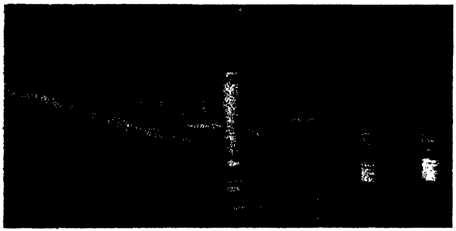
The tank shown in our illustration is of 1,000,000 cubic feet capacity, and a gas holder of this type has recently been built at Flushing, Long Island, which has a capacity of 3,000,000 cubic feet. This tank has a clear height to the under side of the roof of 202 feet, and an internal diameter of 146 feet.

This new design of gas holder is highly meritorious. There is a tendency, today, in engineering to break away from tradition; though it has shown itself more in the smaller than in the class of larger constructions, in which the huge modern gas holders may be classed. Of late years, the spirit of inquiry has put some of our long-established methods of heavy construction under review and with some surprising results; as witness the substitution of the light, single-arched dam for the time-honored, massive gravity dam. The new type of gas holder is an expression of this modern tendency to submit to keen analysis accepted forms of construction.

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

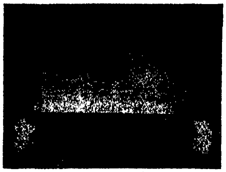


Device for testing the compression in automobile cylinders

The deflation of the balloon indicates the rate of leakage

How Is Your Compression?

A DEVICE for testing the compression in automobile cylinders has been placed upon the market by an Akron, Ohio, company. It is so simple that any car owner can operate it easily and correctly. The tester consists of a plug, similar to a spark plug, which screws into the spark plug hole. A small, specially constructed rubber balloon fits snugly on the end of the plug. After screwing the tester into place, the engine is turned over with the crank until the balloon is inflated. The speed at which the balloon deflates indicates the rate of leakage in the cylinder. There is a metal clip which can be screwed on the tester, which holds an ordinary tire gage. By using the gage, it is possible to compare compression in each cylinder exactly, as the gage will indicate the pressure in each cylinder.



A self-contained parallel straightedge

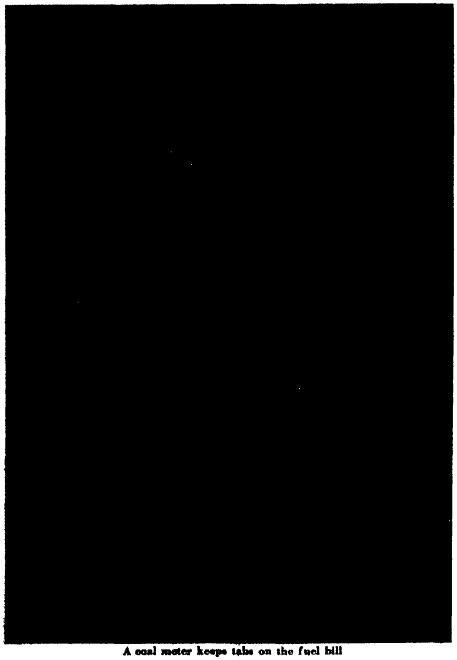
For Drawing Parallel Lines

THIS parallel straightedge is a simple and convenient means of drawing parallel lines. The instrument is rapidly and efficiently secured to the drawing board by means of four special tacks and one thumbtack Except for these five tacks, the straightedge is self-contained, the necessary pulleys being entirely housed between the end plates. The cord passes through the straightedge.

An "efficiency" desk for children

The Automatic Volumetric Measurement of Coal

THE operation of the instrument for measuring coal depends on the automatic recording of the product of the cross sectional area and the velocity of the layer of coal passing into the furnace The meter registers the volume of the coal burnt The method by which this measurement is affected is as follows: The meter is attached to the driving mechanism of the grate in such a way that the speed of a ratchet wheel is varied in proportion to the grate travel. At the maximum gate height, the counter makes a complete revolution with the ratchet wheel, turning off ten units As the gate is lowered, the motion is communicated to a cam which throws the two pawls out of contact with the ratchet wheel during a portion of a revolution, so that the number of units turned off by the counter is decreased in proportion to the amount by which the gate is lowered



A coal meter keeps tabs on the fuel bill

Kitchen Tool of Many Uses

A SMALL kitchen tool having many uses is shown herewith It sharpens dull knives, lifts the milk bottle cap, removes friction covers from jars and cans acts as a bottle opener and as a screw driver

"Kitchenaid" is very useful

School Desk Made Movable

MODERN school desks are movable and designed to induce correct posture in children The desk we illustrate may be changed to a side chair without dismounting It has an inkwell that will not splash or let the ink evaporate It is provided with drawers for books on both sides

The top swings out of the way

A new device for the typewriter space-bar

Color Combination for Typewriter Space-bar Relieves Eye Strain

TO aid typists in avoiding eye strain, a new device to be clipped on the space bar of the typewriter has been invented. The attachment is of light-gage spring steel, 4½ inches long, of square section, one side of which is open so as to slip over the existing space-bar. The top is enameled in nine different colors, including white, orange, yellow, cream, red, carmine, pink, brown and black.

A Telephone "Deaf Set"

ONE of the latest products resulting from the research effort of the Bell Telephone Laboratories is a device—available as yet only to a limited extent—that is designed to make telephone service more effective to those whose hearing is impaired The larger box shown in the picture contains a vacuum-tube amplifier, and the smaller box has switches for adjusting the volume of the amplified speech and for switching the amplifier in or out of the circuit

An All-in-One Sewing Kit

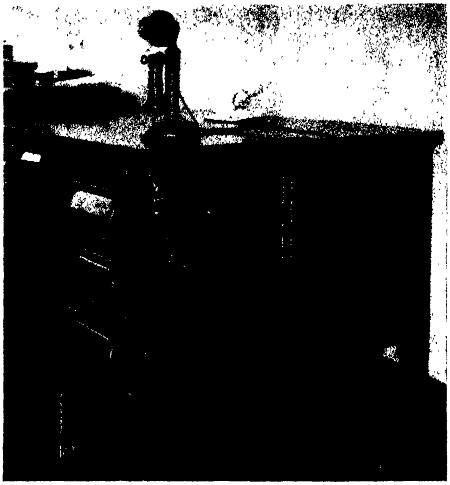
A RATHER clever contrivance for carrying thimble, needle and thread in a hand bag or traveling case, is shown in the engraving. The thimble is threaded so that it screws on the end of the metal case thus providing a tight top for it

Either end of the automobile elevating device may be used

Pencil Clip Used as a Knife

OUR photograph shows a clip that will keep a pencil in your pocket or that may be used as a knife blade This combination tool slips on the pencil and is ever ready for use It has other uses, too, such as raising thumb tacks for draftsmen opening plate boxes for photographers, or skinning insulation from wire

The pencil clip is a knife as well


A telephone for the deaf can be readily installed

A wood and steel work bench for the home or shop

A searchlight on the railway train illuminates the scenery

A handy contrivance for the traveler

Automobile Elevating Device

A SAN FRANCISCO inventor has perfected an automobile elevating device which has a cradle with compensating rollers at each end. Thus, either end of the device may be raised independently of the other without binding either of the elevating pistons.

An Efficient Work Bench for Men or Boys

EVERY boy or man finds a use in these days for a work bench. This new wood and steel bench is of particular interest in that it may be purchased "knocked-down" and can be easily put up anywhere.

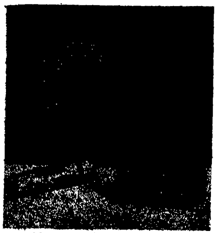
Everybody Can Have an Initialed Car

A FIRM of Chicago jewelers is selling pierced initials for automobiles. The manufacturer has solved the problem of attaching the monogram to the car in a simple way by providing a template which helps in locating the metal initials on the polished surface A cement fills the recesses in the back of the plate, thus furnishing an anchorage to hold it to the car.

Both pistons will elevate the car and keep it horizontal

Observation Car Spotlight Shows Scenery at Night

OUR engraving shows passengers of the "Olympian Limited," of the Chicago, Milwaukee and St Paul Railroad, enjoying a new flood light This light enables night travelers on the road's transcontinental trains to enjoy scenery along the route It is mounted so that it will shift like an automobile spotlight. The light will carry a quarter of a mile and will illuminate a 400-foot area.


Your initials on your auto

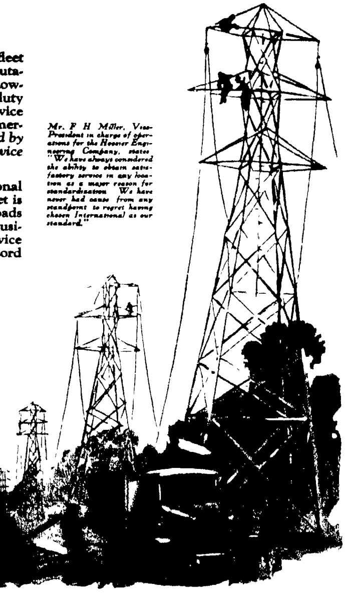
Super-Power Line Builders Choose International Trucks

FROM Maine to the Gulf to the far West go the crews and trucks of the Hoosier Engineering Company of Indianapolis. Their work is the erection of the electric transmission lines that stride in all directions across the nation.

During the past year or so the Hoosier Engineering Company extended high tension towers and lines over ten scattered states. In Wisconsin alone we find them marshalling six hundred men and forty motor trucks. In Florida and Arkansas half as many more. Their daily work is the kind that tries the mettle of trucks—and after six years the result is *heavy-duty standardization on Internationals!*

Summer and winter this Hoosier fleet has lived up to the International reputation for power, dependability, and low-cost operation. And always, wherever duty called the trucks, International service was waiting for them, ready for any emergency. *International Trucks are serviced by the largest Company-owned truck service organization in the world.*

The good work of the International Trucks in the Hoosier Engineering fleet is a good reference for any man with loads to haul. On every hand, in every business, International Trucks and Service have been building that kind of record for over twenty years.



Mr. F H Miller, Vice-President in charge of operations for the Hoosier Engineering Company, states "We have always considered the ability to obtain satisfactory service in any location as a major reason for standardization We have never had cause from any standpoint to regret having chosen International as our standard."

The International line includes the Special Delivery, 1-ton and 1¼-ton Speed Trucks, Heavy-Duty Trucks ranging from 1½-ton to 5-ton maximum capacities, Motor Coaches for all requirements, and the McCormick-Deering Industrial Tractor. Write for complete descriptive literature.

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The Scientific American Digest

Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Two New Methods of Producing Ductile Welds

Two methods for producing ductile welds have been developed by research scientists of the General Electric Company, working in different laboratories hundreds of miles apart. Both of the methods, similar in some respects, mark a decided step in the utilization of the heat of electric arcs in the joining of metal parts or the building of metal structures The one was developed in the Schenectady, New York, research laboratory by Dr Irving Langmuir, the other was developed in the Thomson research laboratory at Lynn, Massachusetts, by Peter Alexander.

In both processes, air is excluded from the metal by means of a bath of hydrogen or other gas The formation of oxides and nitrides in the weld metal is thus prevented, and the fused metal is as strong and ductile as the original metal.

In brief, the method developed by Dr. Langmuir in Schenectady is to pass a stream of hydrogen between two electrodes. The heat of the arc breaks up the hydrogen molecules into atoms These combine again a short distance in front of the arc into molecules of the gas, and in so doing liberate *an enormous amount of heat, so that much* higher temperatures can be obtained with this than with the usual welding methods Since atomic hydrogen is a powerful reducing agent, it reduces any oxides which might otherwise form on the surface of the metal. Alloys containing chromium, aluminum, silicon or manganese can thus be welded *without fluxes* and without surface oxidation

The process developed in the Lynn laboratory by Mr Alexander is based on the utilization of the chemical and physical properties of hydrogen and other gases in their molecular state. This process aims primarily at the prevention of the formation of the nitrides and oxides in the arc deposited metal, which limit the ductility of the usual arc welds

In this process the arc is struck between the metallic wire or carbon used as one electrode and the plate or work to be welded used as another electrode The crater of the arc is always on the work to be welded The *gaseous atmosphere* is supplied in a form of a stream around the arc Pure hydrogen, water gas, hydrogen nitrogen mixtures, anhydrous ammonia, methanol vapor and some other suitable gases can be used, according to the nature of the work The hydrogen-carbon monoxide mixtures were suggested by Professor Elihu Thomson, water gas and methanol are examples of such mixtures

This process makes the arc welding process more efficient and suitable for the fields which at present are out of its reach Low carbon steel, alloy steels, and most of the non ferrous metals and alloys can be welded with success by this process in suitable gaseous mixtures

Photographs courtesy General Electric Co

The automatic wire feeding device used with the new Lynn method of electric welding. The motor slowly advances the wire

Fifteen years ago, while studying the *loss of heat of the tungsten filaments* of incandescent lamps in an atmosphere of hydrogen gas, Dr Irving Langmuir found that at a high temperature the hydrogen gas changed from the molecular to the atomic state In the molecular state, two atoms of the gas are grouped together as a unit, in the atomic state each atom acts as a unit. The molecular form is the more stable, and when the atoms recombine to form the molecules intense heat is liberated.

Dr Langmuir's study of the filaments in hydrogen was a theoretical investigation Now, fifteen years later, the results have been applied in a different field—in the development of a new method of welding, by which it is possible to produce welds as strong and as ductile as the original materials

Continuing the theoretical investigation, Dr Langmuir found that more atomic hydrogen was formed by passing powerful electric arcs between tungsten electrodes at atmospheric pressure. By directing a jet of hydrogen from a small tube into the arc, the atomic hydrogen could be blown out of the arc, forming an intensely hot flame of atomic hydrogen burning to the molecular *form and liberating about half again as* much heat as does the oxy-hydrogen flame In this flame molybdenum, one of the most refractory of metals, melts with ease; quartz, however, melts less easily, in spite of its lower melting point This indicates that the metal assists in the action as a catalyzer—which scientists define as a substance which accelerates a chemical change.

By this method, iron can be welded or melted without contamination by carbon, oxygen or nitrogen Because of the powerful reducing action of the atomic hydrogen, alloys containing chromium, aluminum, silicon or manganese can be welded without fluxes and without oxidation The rapidity with which such metals as iron can be melted seems to exceed that in the oxy-acetylene flame, so that the process promises to be particularly valuable for welding

The technical development of this welding process has been the work of several men in the Schenectady laboratory, including R. A. Weinman and Robert Palmer. These men have developed and tried many types of welding torches, and have tried them under varying conditions. At the same time tests of numerous types of welds have been conducted

The two electrodes of the torch are tungsten rods, held at an acute angle with each other by lava insulators. When not in use, the electrodes are in contact with each other; they can be separated by pressure on a lever mounted on the handle. A set screw is provided for making slow adjustments of the electrodes The hydrogen is supplied by a tube through the handle. Sufficient gas is used so that not only are the electrode tips surrounded by enough to form the blast of atomic hydrogen but by an additional quantity to surround the work with hydrogen.

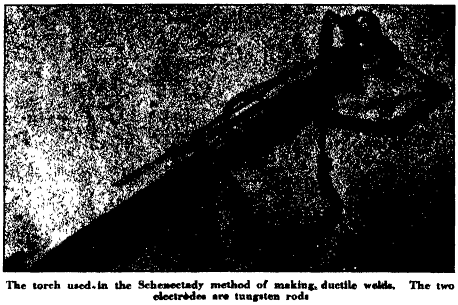
Either alternating or direct current can be used. The first mentioned has been found more convenient, and electrodes of smaller diameter can be used. The gas pressure required to operate the torch is very small; in the laboratory, with short lengths of tubing, a pressure of less than one pound per square inch was sufficient with metals up to one-half inch in thickness. For ordinary welding, the rate of gas consumption varies between 20 and 30 cubic feet per hour.

Experiments have been conducted with several gas mixtures and various electrode materials The best results have usually been obtained with tungsten electrodes and hydrogen alone.

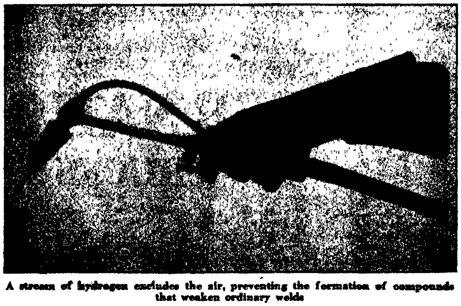
Materials of many kinds have been successfully welded by this method Low carbon steels up to one-half inch in thickness have been welded without additional material, after butting together tightly. Considerable work has also been done in connection with full automatic welding using a butt joint, and with no metal being added to the seam A number of welds have been made on seamless tubing having a wall thickness of one-quarter inch and an outside diameter of four inches, and with boiler plate iron one inch thick Welds on deoxidized copper such as silicon-copper have been made up to three-eighths inch thick metal, giving unusually good sections

In testing welds made by this process, the welded portions have been twisted and bent double without cracking or otherwise being injured. Such a procedure has not been possible with the ordinary arc weld, since such welds are usually brittle because of the presence of nitrides or a thin film of oxide

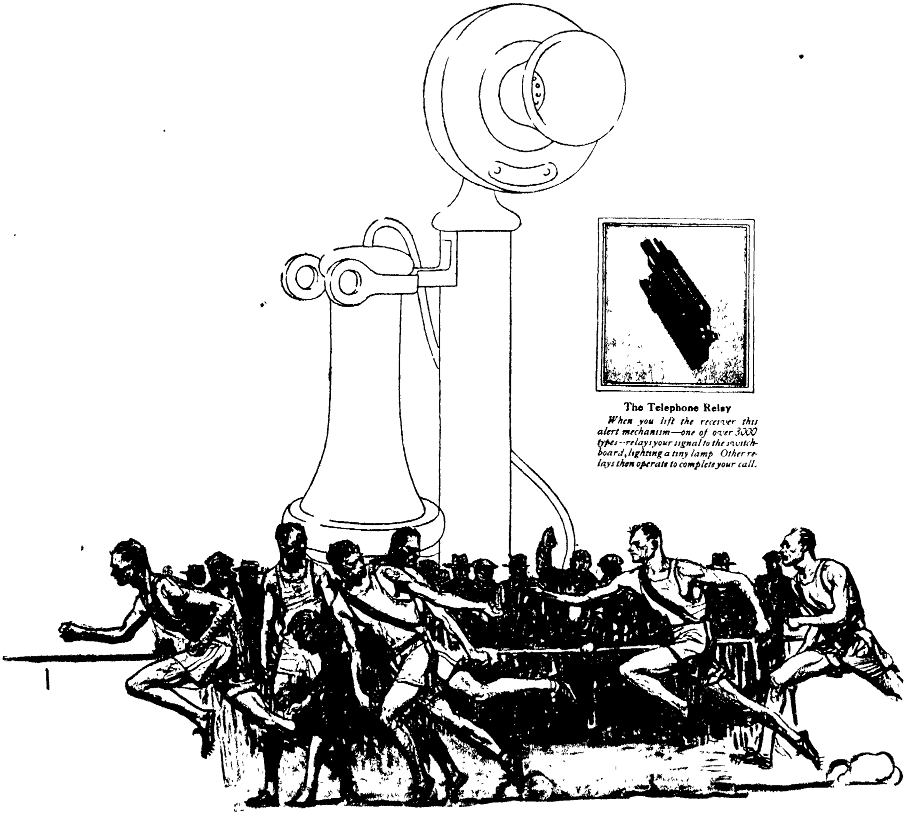
(Continued on page 404)



The torch used in the Schenectady method of making ductile welds. The two electrodes are tungsten rods



A stream of hydrogen excludes the air, preventing the formation of compounds that weaken ordinary welds



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Relay runners in your telephone circuit

The relay runner, carrying on from man to man, finds his counterpart in the telephone relay. Every time you lift your receiver off the hook you set in motion a relay system which, if less thrilling than a race, is infinitely faster and surer to come through.

The telephone relay is the heart of a vast unseen plant which you are apt to take for granted. Like every other part it must be skillfully built—and the whole carefully fitted together.

Western Electric has one hundred per cent responsibility for manufacturing the equipment for the Bell System. It is our business to make everything from relay to switchboard, from telephones to cable, and to make these to the uniform standard—"It must not fail."

Back of your telephone

Western Electric

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Wood that's *stronger* than wood

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Single panels with outer layers in *one piece* may be had in sizes as large as 4 by 8 feet. Standard construction is 3-ply and 5-ply, in thicknesses from ¼ to ¾ inch.

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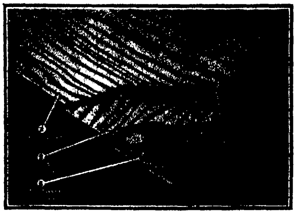
Write for full information regarding Plylock. Samples will gladly be supplied for experimental and development work at your own plant, and our research department is at your service. Send for a copy of "The Pictured Story of Plylock."



Sample of Plylock, 3-ply, cut away to show construction

PLYLOCK

"Wood that's *stronger* than wood"

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makers of plywood for 27 years

Mr. Livengood's reflecting telescope. The axes are Ford axles

or scale, removed in the new process by the presence of hydrogen.

The second method is explained as follows: By surrounding the ordinary welding electrodes with an atmosphere of hydrogen or certain other gases, it has been found by Peter Alexander of the Thomson Research Laboratory of the General Electric Company that it is possible to produce ductile welds. The gas acts as a flux and shield against the oxygen and nitrogen of the air; therefore the formation of oxides and nitrides of iron in the molten metal is prevented. The process originated from the study of metallurgy of the arc-deposited metal and the causes that limit its ductility.

The method is based on the action of molecular hydrogen. This gas at high temperatures, even in the molecular state, is a very active reducing agent. When it surrounds the crater of the arc it acts in the same way as it does in the hydrogen brazing process. Yet certain peculiarities of the process (for example, the extremely high voltage drop at cathode and anode of the arc burning in hydrogen) are due to the dissociation of the small amounts of molecular hydrogen in actual contact with the craters. Hence the apparent resistance of the arc, and consequently the amount of energy liberated, is about double that when the arc is burning in air.

Consequently the weld is not only ductile, but the operation is much faster. The speed results both from the greater energy of the arc in the hydrogen atmosphere and the fact that beveling of the edges of the material is unnecessary. Using 180 amperes and an arc voltage of 60, one-quarter inch boiler plates, butted together without beveling, have been welded at a speed of 60 feet per hour.

Ductility is a factor of prime importance in the welds of structures that are subjected to vibration, accidental bending stress, or overload. Also, ductility equalizes internal cooling stresses when present in the weld If any part of the ductile weld is stressed beyond its elastic limit, it will not crack. It will yield until the stresses are more or less equalized all along the joint, which is so proportioned as to stand with safety the imposed load. It has also been found that the metal deposited in the hydrogen atmosphere has a higher elastic limit. The elastic limit of pure iron electrodes before deposition averages 29,000 pounds per square inch; the elastic limit of the same electrode deposited by the arc in hydrogen averages 42,000 pounds per square inch.

In this welding process the arc is maintained inside of a hydrogen stream which burns along its outer surface of contact with air. The electrode is entirely surrounded by hydrogen, which eliminates the possibility of the metal in the crater coming in contact with air Direct current is used. The equipment as developed in the laboratory includes the direct-current generator, gas hose, and spool of welding wire mounted as a unit on one base. The welding wire, the hydrogen gas and the electric current are sent through a flexible hose to the torch nozzle.

After the work with the hydrogen atmosphere was found to be successful, experiments with mixtures of hydrogen and carbon monoxide were conducted in accordance with Professor Elihu Thomson's suggestion, and under his personal guidance. Water gas, containing about equal volumes of hydrogen and carbon monoxide, was next tried. It was found that welds produced in such an atmosphere were ductile and easier to produce. Work with various mixtures of carbon monoxide and hydrogen, produced either synthetically or by decomposition of various organic compounds, demonstrated that ductile welds can be produced in the atmosphere of any mixture of the two gases. Methanol or synthetic wood alcohol was found to serve well in this gas, so that transportation with portable outfits is facilitated.

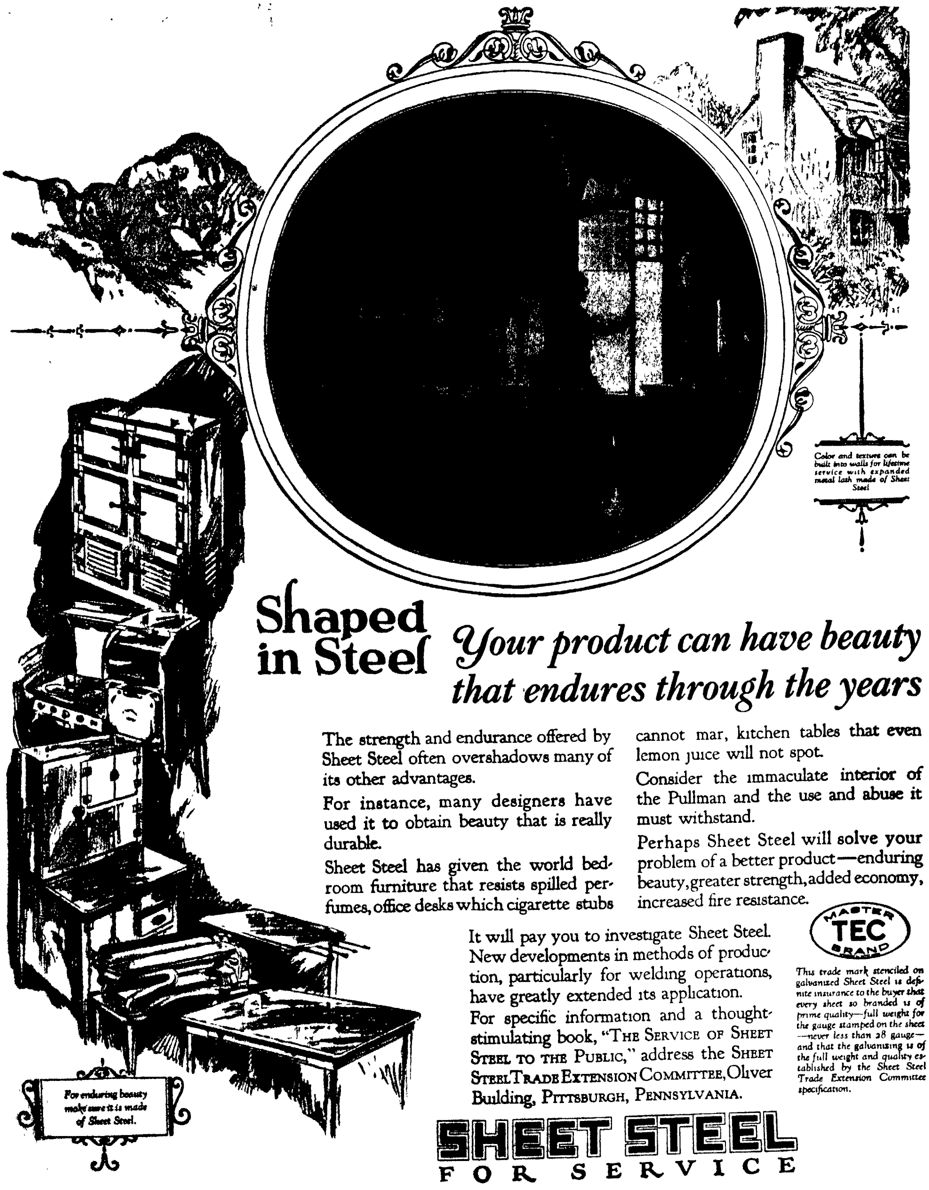
A series of experiments with nitrogen-hydrogen mixtures showed that mixtures of these gases also give ductile welds. The use of liquid anhydrous ammonia which contains one volume of nitrogen and three of hydrogen, in this connection makes it possible to store large quantities of the gas in small volume as a liquid.

Still other gases and methods are being investigated in the Lynn laboratory, and academic studies are being made of the theoretical aspect of welding in different gases.

In its present state the process is being

(*Continued on page 406*)

Mr. Wade's telescope, described on the next page, is driven by a phonograph motor, through a worm wheel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This trade mark stenciled on galvanized Sheet Steel is definite insurance to the buyer that every sheet so branded is of prime quality—full weight for the gauge stamped on the sheet—never less than 28 gauge—and that the galvanizing is of the full weight and quality established by the Sheet Steel Trade Extension Committee specification.

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It combines great strength and resiliency with comparative lightness. Weight for weight, Hard Maple is actually stronger than structural steel. It stands vibration and shock without fracture, and possesses exceptional screw-holding power.

Since it resists warping tendencies and is responsive to all finishes, Hard Maple plays an important part in the furniture industry and in musical instrument manufacture.

Commercially, Hard Maple strikingly illustrates the ultimate triumph of wood, for all its proper uses, over substitutes. Builders of high class auto bodies, after experimentation, insist that wooden frames give the best all-round satisfaction, and the Hard Maple demand for this purpose is rapidly increasing. Bowling alleys and pins, chopping blocks, shipping crates and boxes, are made of Hard Maple because nothing else will bear equal use and abuse.

You may be able to save on production and improve your product by the utilization of Hard Maple. Its advantages surely justify your inquiry.

Our Forest Products Engineering Department will gladly furnish you with authentic data upon the industrial applications of Hard Maple, and will send you the Hard Maple Handbook FREE on request

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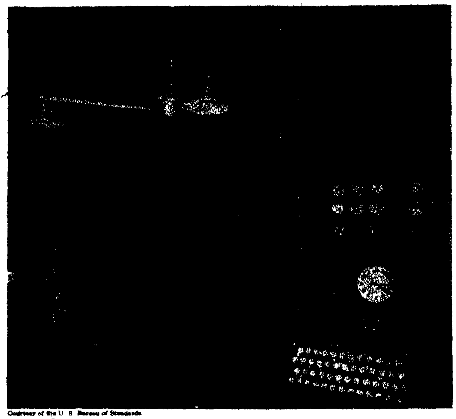
NOTE: Hard Maple may be had in mixed shipments with Beech, Birch and other desirable Northern Hardwoods. Write for list of member mills.

THE HARDEST HARDWOODS
GROW IN THE NORTH


Courtesy of the U S Bureau of Standards

Cabinets for testing timepieces. Their temperature is kept uniform by means of thermostats

extended to the welding of alloy steels, non-ferrous materials and their alloys The careful selection of the appropriate gaseous mixture determined by the nature of the materials to be welded is an essential factor

In brief, this process is a combination of an electric arc which supplies the energy and an appropriate chemical reagent which, being in a gaseous state and at extremely high temperature, acts almost at once

* * *

Two Ford-Parts Telescopes

Two well made reflecting telescopes, having in common the use of the rear axles of Ford cars for the polar and declination axes, and constructed by Mr Lester M Livengood, of Spokane, Washington, and Mr A Wade, of Los Angeles, California, are shown on page 404 The original Ford axle mounting was described by Mr Clarendon Ions, of Miami, Florida, in *Popular Astronomy*, February, 1925 (description reprinted in "Amateur Telescope Making," 1926, Scientific American Publishing Company, New York) In both telescopes the parts of the Ford rear axle assemblies, which may be picked up at very low cost at public garages, show clearly

Courtesy of the U S Bureau of Standards

Fiefler clock, the standard for timepiece tests. Accurate to .02 second per day

Mr Wade states that the tube of his telescope is a section of ten-inch irrigation pipe. His mirror is ten inches in diameter. The driving clock is an old phonograph motor, with gearing interposed. He states that the barrel which shows in the background of the picture is the stand on which his mirror was made. With the exception of some welding, all work was done at home.

Mr Livengood did not include a description of his telescope, which however, quite closely resembles the original Ions mounting. In this, the base was made of concrete.

Neither of these instruments was originally inspired by the recent effort of the Scientific American to arouse interest in amateur telescope making, having been finished previous to that effort. Noting our effort, the respective makers sent us photographs of their creations.

Before long, photographs should begin to reach us from the first thousand amateur enthusiasts who began work on their telescopes shortly after the publication of the book, "Amateur Telescope Making," in March Preferably, such photographs should include the makers, since they are more interesting thus.

* * *

Testing Timepieces at the Bureau of Standards

CERTAIN definite tests have been arranged by the United States Bureau of Standards for three distinct classes of timepieces, namely: pocket watches, stop-watches, and chronometers, according to R E Gould Special tests are also prepared for other forms of timepieces, such as clocks, where no specified test has been provided.

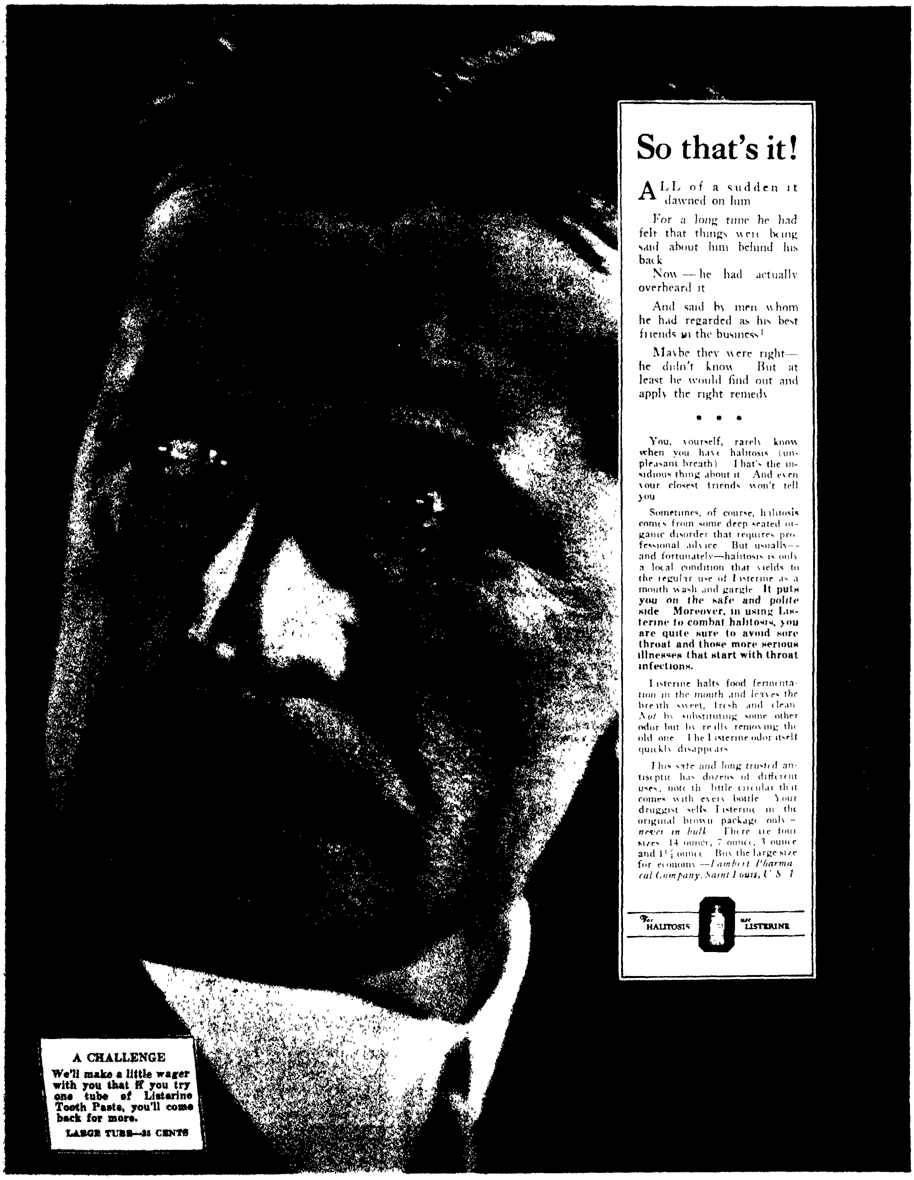
The standard for all such tests carried out at the Bureau is the Riefler clock. This is kept in a constant temperature room in the basement of the building. This clock varies only about 0.02 second a day, and it is compared each day at noon with the Naval Observatory signal, as relayed by radio from Arlington

The seconds ticked off by this standard clock are transmitted to the testing laboratory through a relay, where they are recorded on a drum chronograph, by a pen. This same pen may also be made to record on the same sheet other signals given by a telegraph key which is inserted in the circuit, and operated by the observer.

As a reading on a watch is made the observer closes the key and thus makes a permanent record on the chronograph sheet, of the exact time of the operation. The difference between the true time and the observed time gives the correction to the watch reading and this correction, compared to that of the previous day, gives the rate or daily change in the watch reading. This method of recording results is used for all timepieces.

The tests of pocket watches cover both positions and temperatures, and are divided

(*Continued on page 408*)



So that's it!

ALL of a sudden it dawned on him.

For a long time he had felt that things were being said about him behind his back.

Now — he had actually overheard it.

And said by men whom he had regarded as his best friends in the business!

Maybe they were right— he didn't know. But at least he would find out and apply the right remedy.

* * *

You, yourself, rarely know when you have halitosis (unpleasant breath). That's the insidious thing about it. And even your closest friends won't tell you.

Sometimes, of course, halitosis comes from some deep seated organic disorder that requires professional advice. But usually— and fortunately—halitosis is only a local condition that yields to the regular use of Listerine as a mouth wash and gargle. **It puts you on the safe and polite side. Moreover, in using Listerine to combat halitosis, you are quite sure to avoid sore throat and those more serious illnesses that start with throat infections.**

Listerine halts food fermentation *in the mouth and leaves the* breath sweet, fresh and clean. *Not* by substituting some other odor but by really removing the old one. The Listerine odor itself quickly disappears.

This safe and *long trusted* antiseptic has dozens of different uses; note the little circular that comes with every bottle. Your druggist sells Listerine in the original brown package only— *never in bulk*. There are four sizes: 14 ounce, 7 ounce, 3 ounce and 1½ ounce. Buy the large size for economy.—*Lambert Pharmacal Company, Saint Louis, U. S. A.*

For HALITOSIS use LISTERINE

A CHALLENGE

We'll make a little wager with you that if you try one tube of Listerine Tooth Paste, you'll come back for more.

LARGE TUBE—25 CENTS

The Telephone at the Centennial

ONE hundred years after the signing of the Declaration of Independence, the infant telephone was first exhibited at the Philadelphia Exposition.

Since the dawn of civilization, mankind had sought some means of communicating over distances which unaided human speech could not bridge. Drums, signal fires, runners, the pony express, and finally the electric telegraph were means to get the message through. It remained for the telephone to convey a speaker's words and tones over thousands of miles.

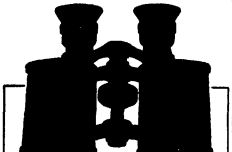
"My God, it talks!" exclaimed the Emperor of Brazil before a group of scientists at the Philadelphia Exposition, as he recognized the voice of Alexander Graham Bell, demonstrating the new invention.

Today, after a brief half-century, the telephone lines of the Bell System have become the nerves of the nation. The telephone connects citizen with citizen, city with city, state with state for the peace and prosperity of all.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION



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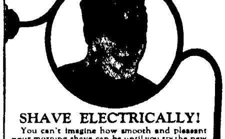

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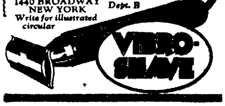


into three classes, namely: "Class A," "Class B" and "Railroad Precision."

"Class A" is a very accurate test consuming 53 days and putting the watch through five positions, three temperatures, and a test for isochronism, that is, the hourly change in rate as the watch runs down Three days are given to each position and five days to each temperature, with an intermediate day for change of temperature.

The "Class B" test is a less severe test than "Class A," two of the positions and the test for isochronism being omitted. The test covers 40 days and is applied largely to watches which have failed to meet the requirements of the longer test.

The "Railroad Precision" test requires only 19 days, but is equal in most respects to the other two tests. It devotes only two days to each of the five positions and three temperatures, and furnishes a much quicker means of judging the performance of the watch.

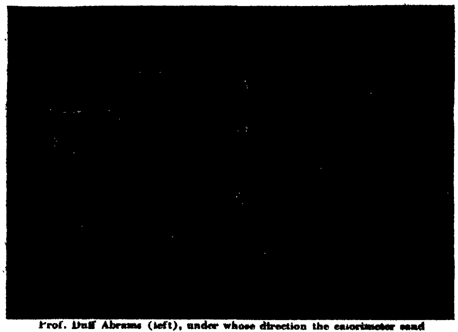
The stop-watch test consists of determining the corrections for various intervals ranging from 30 seconds to five minutes, the results being recorded on the record sheet by the closing of an electric circuit In the case of pocket chronographs the daily rates in the vertical "pendant up" position and the horizontal-dial-up position are also determined.

Chronometers are tested for three temperatures and for isochronism, the test being divided into eight periods of three days each with intermediate days to allow for temperature change Isochronism (uniform in time) is taken for 36 hours to determine the regularity of performance through the day when the chronometer is kept at a constant temperature.

This test usually takes about one month.

More complete information than the above may be obtained from the Bureau of Standards (Washington, D. C.) Circular 51.

* * *



Prof. Duff Abrams (left), under whose direction the colorimeter sand test was perfected

A Simple Color Test for Concrete Sand

THAT sand must be clean before it will make strong concrete is a common saying But investigators of the Structural Materials Research Laboratory, maintained by the Portland Cement Association in cooperation with Lewis Institute, Chicago, have discovered through experiments covering a period of years that "clean" is a rather broad term. So says G. E. Warren, Assistant General Manager of the Portland Cement Association

"Dirt" in sand has long been the bane of contractors, whose success depended on turning out work that measures up to the possibilities of the material. However, the average cement user would be hard put to define "dirt" Tests show that some sands which apparently contain considerable dirt will make fair concrete, yet some sands which appear clean to the eye will produce inferior concrete.

Appearance is not at all conclusive in deciding on the worth of sand to mix with cement.

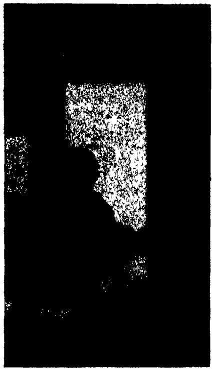
Experimenters at the Structural Materials Research Laboratory have determined through thousands of tests that the only forms of "dirt" which are detrimental to concrete are organic in nature, usually humus, although an excess of any foreign material will be harmful, whether "dirt" or not. In addition to these, there are certain wastes from industrial processes which will

Test solutions for concrete sand. *Left:* Suitable for most exacting concrete. *Center:* Safe where exceptional strength is not required. *Right:* Unsafe unless sand is thoroughly washed prevent the formation of a strong concrete.

Humus and the industrial wastes prevent concrete from hardening properly. The cementing action is delayed, and when it does occur the resulting mass is weak.

The harm from humus arises from the acids formed by all decaying vegetable matter. These react chemically with the cement and prevent it from hardening normally. Such acids vary, of course, with the nature of the vegetation from which the humus is derived. While the formulas of these acids may differ, their general properties are such as to group them into a broad class. And of this class, tannic acid—produced by the decomposition of oak leaves and bark—has been chosen by research workers as the yardstick because its reactions are typical of so many others.

Tannic acid in water reacts with sodium hydroxide to produce a dark colored solution. The other acids found in humus are not identical with tannic acid. But empirical experience has shown that with very few exceptions they, too, produce the same brown color when treated with a sodium hydroxide solution. It should be noted, however, that lignite, which is not a serious detriment, produces a dark brown reaction which frequently deceives the inexperienced



Crushing a cement mortar cylinder at the Structural Materials Research Laboratory. The accuracy of the sodium hydroxide determination of the suitability of sands has been verified thousands of times by these crushing tests

Once the foregoing facts became established, it was easy to devise a colorimetric test for concrete aggregates. The stronger the acid, the darker the color. Hence, to determine the suitability of any fine aggregate for cement, it is necessary only to mix a small portion with a sodium hydroxide solution and observe the shade resulting.

The standard field test is made as follows: Fill a 12-ounce prescription bottle to the 4½-ounce mark with the sand under examination. Add sufficient 3-percent sodium hydroxide solution to bring the total volume to the 7-ounce mark. Shake thoroughly and allow to stand 24 hours. The color of the solution then determines whether the sand will make sound concrete.

If the color is light yellow—like very weak tea—the sand is reasonably free from organic impurities. If the color is slightly darker, the sand may still be used, but not for high-grade work like roads, pavements or reinforced building construction. If the color is definitely brown, it should not be used as it stands in any concrete. Often the humus may be washed from such sand. But no matter how thoroughly it is washed, it should not be employed until the test shows a light colored solution.

Sometimes the rejection of a quantity of

Grinding - and its Part in Motor Progress

In 1905, the first Norton grinding machine was sold into the automobile industry. Grinding at that time was not a factor in machining operations. To-day, many types of grinding machines perform hundreds of operations in this industry. Grinding departments of the great automobile plants are hives of production activity.

With the development of abrasives, grinding wheels and grinding machines has come the development step by step of the motor car. Precision with quantity production has been the goal. Comparison of the car of today and its cost with that of twenty years ago shows what grinding has helped to accomplish. Comparison of street traffic of twenty years ago with today tells a similar story.

The automobile is but one of many modern machines of general usefulness made possible by the help of the abrasive industry.

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New York Chicago Detroit
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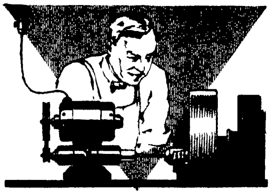
Bauxite Plant Bauxite, Arkansas
Abrasive Plants
Niagara Falls, N. Y., and Chippawa, Ont.
Grinding Wheel Plants
Worcester, Mass. Hamilton, Ont.
La Courneuve, France Wesseling, Germany

NORTON
Grinding Wheels Grinding Machines
Floors and Stair Treads Refractories



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EVERY saving in costs makes a welcome addition to manufacturing profits. By furnishing ideal, economical power for small grinders, drills, blowers, routers, coil winders, etc. Dumore motors have made for themselves a permanent place in the industrial world. New uses are constantly developing.

Wherever a power unit of ¼ of a horsepower or less is needed, there is a profitable place to use a Dumore motor. Speeds range up to 15,000 R.P.M. Dumore quality throughout.

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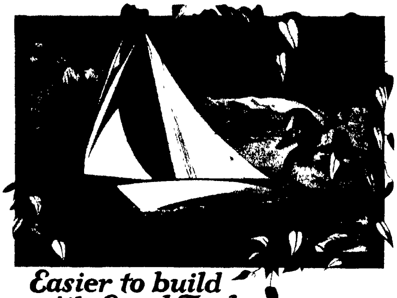

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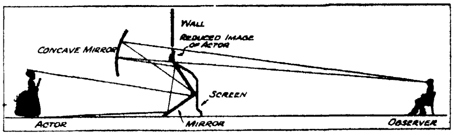
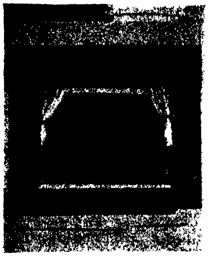


Optics of the Tanagra Theatre. The lower plane mirror inverts the image, the upper one re-erects it. The concave mirror then reduces it to miniature size

sand would mean a considerable financial loss Then it may be worth while to ascertain whether the dark reaction given is not due to the presence of lignite. This, as has been said, is not a serious detriment except for the most particular types of work Lignite is a form of coal, and will appear as small black grains mixed with the lighter particles If such grains are observed, the final determination of their nature should be left to a laboratory. It is almost impossible for the layman to distinguish them from several forms of humus.

If the colorimetric test gives a light reaction, and yet the mix refuses to harden or is unusually slow in gaining strength, investigation should be made for industrial waste in the mixing water



How the actors appear to the viewers, in miniature. The term "Tenagra" is from the ancient Greek town where miniature figurines were made in pre-Christian times

Silt in small quantities does not always lower the quality of concrete, but where a great deal of it is present the strength may be seriously affected. If the aggregate be coated with silt, the cement will fail to get a good grip on it If the silt be merely mixed in the mass without coating the aggregate, its presence in large quantity will require so much additional water to make the mix workable that the resulting concrete will be weakened

If the silt is of an organic nature the test described above will reveal it by the color. But if the silt is inorganic and no dark color appears, it can still be detected by the muddiness of the water in the test bottle when it is first shaken When everything has settled the silt can be seen as a fine powder lying on the sand.

Tests show that humus equal by volume to only 25/1000 of 1 percent of the total mix may rob it of from 10 to 15 percent of its strength Any humus which would give a really dark brown reaction to the sodium hydroxide would represent probably 1/10 of 1 percent of the volume of the sand If the sand contains as much as 1 percent humus by volume, the strength of the cement would be cut anywhere from 50 to 75 percent. Possibly the mass would not harden into concrete at all

Corresponding figures have not been worked out with regard to silt. But it is known that one pint too much of water in a one-bag batch will weaken the mass as much as though two or three pounds of cement were left out.

The safest method of insuring strong concrete is to select aggregate so free from contamination that the colorimetric test will serve merely as a check on the quality However, if the check fails to reveal a low organic content, the aggregate should be rejected or washed thoroughly. Concrete made with it would lack the desired strength and durability. In case the organic content was very high, the concrete might even fail.

* * *

The Lure of the Tanagra Theatre

WHICH one of us has grown too blasé not to remember those joyous days of our earliest youth when we watched, wide-eyed and open mouthed, those funny Punch and Judy shows and those delightful Marionette theatres, with their weird, grotesque characters, whose antics caused our sides to ache with laughter? Now we have a more scientific form of amusement in the Tanagra theatre. Tanagra figures were made of terra cotta in Tanagra, a town of ancient Greece. The little statuettes date back to the fourth and fifth century B C. To these figurines the Tanagra theatre owes its name.

Visualize, for a moment, a miniature stage, the greater part of which is taken up by a console, fashioned along classical lines Placed upon it, in a Grecian vase, is a beautiful Maréchal Neil rose, against a subdued background The small audience, perhaps two or three dozen persons, is watching the attractive setting with eager anticipation, when suddenly—as if by magic—an elfin-like maiden seems to rise from the petals of the rosebud.

The combination of the soft, dreamy strains of Offenbach's "Barcarole" and the scented atmosphere add greatly to the illusion of the Tanagra figures. One is in fairyland.

The mirror arrangement, showing the backs of the two plane mirrors and the front of concave mirror

With a captivating grace and charm impossible to describe, the little Tanagra dancer pirouettes along the subdued background, her dainty form hardly larger than a tiny Dresden doll—now seemingly floating through the air, and then, as if by magic, disappearing in the rose petals, whence she came.

The entrancing strains from "The Tales of Hoffman" die away, slowly the soft lights become brighter and brighter, yet, there we of the audience sit, spell-bound, scarcely able to realize that the graceful miniature dancer is a real, live adult, dancing behind the stage, whose image through a set of mirrors, has been transformed into a little fairy. Naturally, we want to know how this effect is accomplished.

Upon visiting back-stage we are shown a comparatively simple arrangement, consisting mainly of two mirrors at right angles, placed near the ground. Into them the image of the dancer is thrown against a darkened background. This image is then reduced in size by a parabolic mirror in the rear, which reflects the greatly reduced image against the background of the rose and vase.

The illusion is perfect; and upon seeing this comparatively simple equipment, we wonder why more of these charming little Tanagra theatres are not being used in America.

Naturally, the arrangement need not be confined to vases and dancers. Very striking effects may also be obtained, by displaying a fish bowl or an aquarium on the console, within plain view of the audience, in which the effect of a swimmer disporting herself among strange fish and deep-sea creatures is presented. This swimming illusion may be accentuated by the crawling and stroking motion of the actual performer, who is suspended back-stage by a thin wire invisible to the audience. The illusion of angels descending from heaven may thus be accomplished, and the effect of other forms of expensive trick-staging and film photography may be produced at a fraction of the cost of methods heretofore employed.

Shop windows, too small to allow proper display of merchandise by living models, have also effectively used the Tanagra theatre system by employing space back of the window. In this manner it has repeatedly been possible to stage entire miniature acts, displaying special merchandise and demonstrating them before such crowds that traffic was actually halted. To the uninitiated the effect is quite baffling and in a comparatively short time the advertising value derived therefrom more than pays for the cost of the equipment.

* * *

Sound Waves and the Architect

UNTIL quite recently there was no such thing as a science of architectural acoustics In designing auditoriums, architects worked largely on the hit-or-miss basis. When the auditory properties of a room turned out good, it was a sheer stroke of luck When they turned out bad, all sorts of partly successful, partly futile efforts were made in an attempt to correct the mistakes

The chief acoustic factors with which the architect must deal in designing an auditorium are the materials for the walls, the ceiling and the floor; also the shape of the room. An ingenious method of sound-wave photography has been developed at the Riverbank Laboratories, Geneva, Illinois Thus, it becomes possible to study the acoustical properties of any given architectural design. First of all, plaster of paris models of a horizontal section and a vertical section of the auditorium are prepared, exactly to scale.

The apparatus by means of which this is accomplished is shown in diagram on next page. A plaster of paris model of the tentatively designed auditorium is placed over and around the apparatus for making electric spark. The latter creates a single sound wave and an instant later there comes another flash for the purpose of photographing (literally, it is not photographing, but "shadowgraphing") the shadows of the resultant waves on a photographic plate.

Inasmuch as sound travels at 1,100 feet per second, depending slightly on temperature, and since we are dealing with waves at most only a few inches from their source, it is evident that in these experiments we are dealing with very small time intervals; these lie, in the average case, between 1/1000 and 1/20,000 of a second.

The control of the sound-producing spark and the light-producing spark is accomplished by means of trigger gaps which are struck in rapid succession by a bullet fired from a high-power rifle. The trigger gaps can be spaced closer or farther apart, in order to secure the desired time interval. As the rifle bullet passes through each trigger gap, it permits the high-tension electric

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2 *The right wood for each purpose.* You might talk your problems over with the Weyerhaeuser Representative. Get his recommendations. What Weyerhaeuser has contributed to crate users, for instance, is industrial history.

3 *The species and grade you order*—not some kind of lumber that somebody else thinks is good enough for you so long as you don't know the difference.

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5 *Lumber of standard grades* and uniform in grade time after time. The specification of lumber by *obsolete, local* or *special grade* names may get you a cheap price but *not the same lumber.*

6 *Full tally, species, grade and quantity.* About this matter of tally, you can buy lumber today on *different* units of measurements: board feet, surface feet and lineal feet. Therefore, it is well to specify the unit of measurement you are buying—and then to *know* that it is actually delivered.

7 *Lumber scientifically logged,* manufactured, processed and seasoned.

8 *Resources of 17 saw mill plants,* served by modern logging camps in as fine stands of timber as grow anywhere.

9 *Shipment within 24 hours,* if necessary, from three fully equipped Distributing Plants at Baltimore, Portsmouth and Minnesota Transfer.

10 *The personal interest* of Weyerhaeuser Men in each of the customers they serve—an asset that the man who forever shops around for a "cheaper price" never dreams of.

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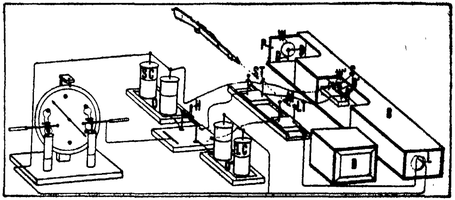


The apparatus for the study of the sound waves produced when a high-powered rifle is fired. The details are explained in the text

charge to pass from the condensers to the respective spark gap. The condensers, in turn, are charged by means of a static machine, well known to the physics classroom.

In the diagram, an ordinary photographic plate *P*, is placed at end of shadow box, *B*. Upon this plate an intense electric spark at *L* casts a shadow of anything between it and the plate. If, therefore, an earlier spark at *S* has produced sound waves, the shadows of those waves will fall on the plate. *W'* represents expanding sound wave, and *W* represents its shadow on the plate. Small disks *D'* prevent the sound spark from fogging the plate. *R'* and *R* are the stand and shadow, respectively, of sound spark gap. The two spark gaps are controlled by trigger gaps *ST* and *LT*, respectively, which in turn are operated by a bullet *M* from a high-power rifle which passes through them, thus permitting high-tension electric charges to jump across the trigger gaps and operate the two spark gaps in rapid succession. The high-tension electric charges are supplied by condensers *SC* and *LC*, on stands *O* and *O'*, which are charged by the static machine at the left. The switch *H* prepares the condensers for a charge or discharge. *B* is a sand box to catch the high-power bullet

By studying the cryptic lines on the photographic plate obtained with this sound-wave photography apparatus, the skilled technician interprets the performance of the architectural design. Thus it becomes possible to test the architect's plans while they are still in the blueprint stage.

* * *

Electrical Treatment Fails to Influence Plant Growth

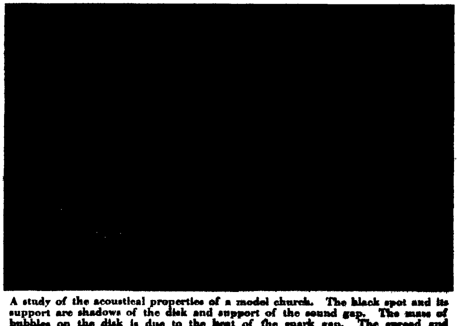
EXPERIMENTS for testing the influence of electricity on plant development have been conducted in various places and under varying conditions of refinement during the past 75 years. Results have varied so much that at the present time there is still a diversity of opinion concerning the influence of electricity on plant growth, says the United States Department of Agriculture.

Some of these experiments in "electroculture" indicate that the yield of crops can be materially increased by electrical treatment. Others, conducted along similar lines, fail to show any marked response to the treatment. The United States Department of Agriculture has failed to discover any marked reaction of plants to electrical treatment in any of the experiments in which it has had a part.

In the department tests the application of electrical force to plant life was made by means of a charged network placed over the growing crops, high enough to permit of their cultivation with horse-drawn implements. In most of these tests the potential of the network was approximately 50,000 volts. The network was charged throughout the night, from late afternoon until early morning, the plants being subjected to electrical treatment about 656 hours in all, extending over the period from June 20 to September 16. Yields of the vegetable crops so treated were so lacking in uniformity that no great dependence could be placed on the results. And furthermore, only in one of the ten trials recorded did the treated plat show any evidence of a substantial increase in yield when compared to the check plats. Experiments of this nature have been conducted by the department over a period of eight years during which time no well-defined increase in yield of the crops tested has been secured.

The department tests were conducted under the same general experimental procedure as that employed in experiments which were conducted in England in which the electrical treatment is reported to have increased yields.

A report of the work done by the Department of Agriculture has just been published and includes also a brief account of other investigations in the field of electroculture. The report is known as Department Bulletin No. 1379, Electroculture. A copy may be secured while the supply lasts by writing to the United States Department of Agriculture, Washington, D. C.



A study of the acoustical properties of a model church. The black spot and its support are shadows of the disk and support of the sound gap. The mass of bubbles on the disk is due to the heat of the spark gap. The spread and reflexion of the sound waves show clearly

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

Wide World

Admiral Moffett demonstrating to the House Committee on Naval Affairs plans for a giant airship of 6,000,000 cubic feet capacity, nearly three times that of the *Shenandoah*, and carrying five airplanes for defensive purposes

Superairships

THE disaster of the *Shenandoah* was far from convincing the Navy that the construction of large rigid airships should henceforth be abandoned. Admiral William A Moffett has convinced the House Committee on Naval Affairs that development of this type of aircraft must continue. A bill now before the House calls for the construction of two giant airships far larger than the *Shenandoah*. They are to have a capacity of 6,000,000 cubic feet, a length of 785 feet and a diameter of 122 feet, as compared with the *Shenandoah's* 2,100,000 cubic feet of gas volume, length of 680 feet and diameter of only 79 feet. They will cost $4,000,000 a piece, or about twice as much as the cost of the *Shenandoah*.

Is there any justification for such construction in increased sizes? Admiral Moffett gave many powerful arguments to the critical House Committee. The volume of an airship goes up as the cube of its linear dimensions; its surface and area projected on the line of the wind only as the square of the linear dimension. Hence the larger the airship the less the power required proportionately to drive it through the air at the same speed. The *Shenandoah* could only make 64 miles an hour. The proposed airship would make 85 miles an hour, and increased speed makes not only for greater military utility but also for increased safety by virtue of ability to outspeed a storm. Also, with the larger airship a stronger hull, and an increased radius of action are possible. The military load carried also increases.

The airship which is shown in our photograph would be able to carry in addition to fuel for a range of 7,000 miles, five or six fighting airplanes, and machine gun platforms at many points. Filled with helium gas so that it is not highly vulnerable to gun fire and provided with these machine guns, and readily releasable airplanes, the proposed airship would be able to fight off even a powerful airplane attack. Moffett summarizes the military advantages as follows:

"With an airship such as can be built, I would not hesitate to venture into any theatre of operations for the purpose of obtaining information of the enemy forces. If an enemy airplane is encountered and flies over the airship firing bullets into it, the holes made in the gas cells will be stopped by the crew before any considerable loss of gas is encountered"

This revival of interest in large airships is strengthened by the fact that the British Government is actively pushing the construction of two airships, likewise of 6,000,000 cubic feet each, to be used on completion in an Imperial service from Cairo to Karachi, India One of these is to be built of stainless steel and will be equipped with heavy, oil-burning engines to offset the dangers of the inflammable hydrogen which Great Britain is forced to use for lack of a supply of helium. The other British airship is to use gasoline engines and to have a structure of duralumin The lead of the ultra-conservative English is not to be disregarded.

A Novel Engine Mounting

THE Udet Company of Germany has recently brought out a four-engined passenger plane, with the engines spread out under the wing. A pilot and a navigator occupy a cockpit at the front part of the central fuselage where their vision is scarcely impeded in any direction. The passengers are seated in eight comfortable armchairs in a roomy cabin, to which ingress is but a matter of a high step from the ground through a large door.

The plane has every indication of an excellent design. But it is the engine mounting which is most interesting. The use of four engines is a safeguard against engine failure, since flight should be possible with any two engines out of commission, or at least with an engine on either side out of commission. The placing of engines on the wings of a monoplane offers many difficulties however. The propeller placed in front of a wing may influence its efficiency unfavorably and the engine nacelle itself is hard to streamline.

The Udet Company has met these diffi-

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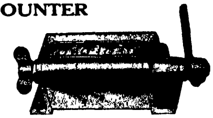
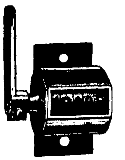
Veeder
COUNTER

The large Set-Back Revolution Counter at right is less than ½ actual size The small Revolution Counter below is shown nearly full size





The Set-Back Revolution Counter above records the output of the larger machines where the revolutions of a shaft record operations or output Counts one for each revolution, and sets back to zero from any figure by turning knob once round Supplied with from four to ten figure-wheels, as required Price, with four figures, as illustrated, $10 00 (subject to discount)

The Small Revolution Counter at left records the output of smaller machines where a shaft revolution indicates an operation Though small, this counter is very durable, its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines Will subtract if run backward Price, $2.00.

There's a VEEDER to fit every machine—and every need in production-getting. The Veeder booklet shows scores of counters; write for this free guide to cheaper production.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

A rear view of the four-engined Udet monoplane. The passenger proceeds to a roomy cabin by a door which is not far from the ground and is large enough to avoid any effort in entry or exit

culties in an ingenious fashion The propellers are "pushers" not tractors, therefore they do not interact with the wing. There being no propeller in the way, the front of the engine nacelle can be beautifully streamlined. And, as the propellers are driven through a fairly long transmission shaft, the rear of the engine nacelle is also of the best aerodynamical form. While the introduction of a transmission shaft may not please the conventional designer, the decrease in air resistance achieved thereby is of real value.

Ideas

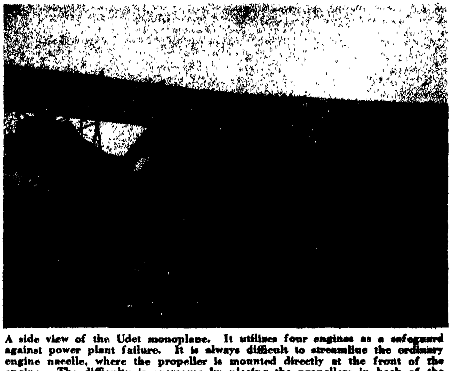
EVEN though the art of aviation is yet young, aeronautical conceptions have a tendency to become stereotyped. It is refreshing to read in *Aviation* an article on "Possible Lines of Aeronautical Development," which embodies radical yet plausible suggestions

It seems to be the consensus of opinion that passengers will not make use of parachutes The design of a parachute which should waft the passengers to safety without their own volition is fraught with difficulties Why not make the rear part of the central fuselage readily detachable and so designed as to carry the lower wing of a biplane and the tail surfaces with it? With very careful design it might be possible to make this rear portion an independent glider In case of fire or other impending disaster, the pilot would pull a lever and guide his auxiliary airplane to safety There are in such a plan, structural difficulties, difficulties in balancing the craft as a whole and the glider separately, and at the moment of separation trouble might be experienced in the disturbed air. Still, the idea is worth thinking about. We are told that Edison himself has been thinking along these lines.

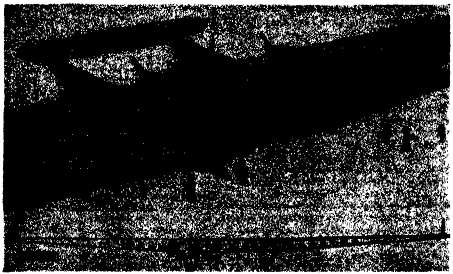
Devices for reducing landing speed are innumerable Perhaps the most noteworthy is the Handley Page slotted wing, (already described in these columns) with which it is possible to increase the lifting capacity of a wing 100 percent at the moment of landing Now comes the idea that a very thick monoplane wing might be so arranged that the under part of the wing would at a given moment drop a few feet below the main wing, thus converting the monoplane into a biplane and providing extra lift. If used in conjunction with the Handley Page slot, the increase in lift would be very powerful Perhaps the mechanical difficulties might not prove insuperable

A Daring Conception

THE well known German constructor, Junkers, recently exhibited at a Swedish aircraft meet a model of a proposed airplane which is decidedly novel in conception. The airplane is to consist of a large wing, 180 feet in span, and without external bracing, with a depth of 6⅓ feet at the



A side view of the Udet monoplane. It utilizes four engines as a safeguard against power plant failure. It is always difficult to streamline the ordinary engine nacelle, where the propeller is mounted directly at the front of the engine. The difficulty is overcome by placing the propellers in back of the engine and driving them by a transmission shaft



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A 12-foot model of the Junkers flying wing

center section. There is no fuselage of the usual type and the passenger accommodations are to be entirely within the wing, with large "skylight" windows to provide lighting and illumination.

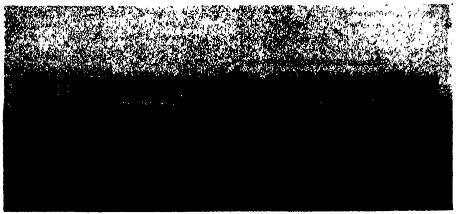
A special sound proof compartment is designed to minimise the noise of four 1,000-horsepower, oil-burning engines, to be built on the Diesel engine principle Two rudders are fixed at the rear edge of the wing, and the elevator is to be carried on two horns or booms ahead of the wing Wind tunnel results are said to have been entirely satisfactory.

Engineers are generally of the opinion that no matter how large an airplane must be, it must still have conventional forms for control and stability. Is the rudder control sufficient, seeing that the leverage of the rudders is so small? And the same question arises in reference to the elevators Perhaps the idea is that a very large machine is more likely to keep on an even keel and normal flight attitude, and that controls need not have relatively the same power But a great deal of both theoretical and wind tunnel investigation would be necessary before this viewpoint could be accepted.

A Vivid Strength Test

JUNKERS'S conception of the flying wing may be treated with respect because he does build excellent airplanes of more conventional type The two illustrations show one of his latest planes, a large three engined, all metal airplane which is maintaining a service between Amsterdam in Holland and Malmo in Sweden It accommodates 14 passengers in a roomy cabin and two pilots in a cockpit placed at the forward end of the fuselage

It is customary to test airplanes by inverting them and loading them with piles of sand bags in a manner simulating the forces in flight Placing 61 men on the wing is a vivid and imaginative method of demonstrating the strength of an airplane



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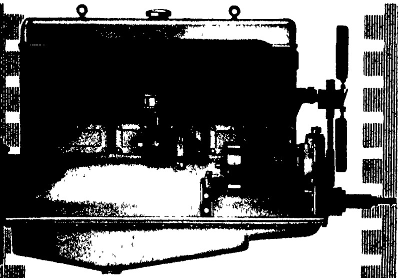
Testing the wings of the Junkers all-metal plane

P. and A. Photos

A good idea of the size of the Junkers three-engined, all-metal plane may be gathered from the small two-passenger plane standing under it



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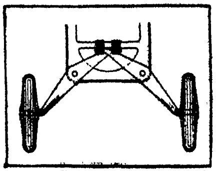
An Interesting Landing Gear

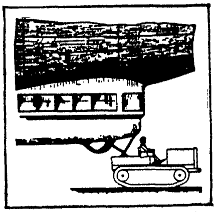
FOR many years designers have been turning their attention to internally braced wings, in which all external struts and wires disappear and the aerodynamic resistance of the wing truss is considerably diminished. The German engineer, Dornier, has extended this principle of internal bracing to the landing gear—which in the conventional type has an air resistance of 50 percent or more of that of the body of the airplane.

The principle of his landing gear is illustrated in the appended sketch from *Zeitschrift für Flugtechnik.* The landing gear has no axle and no bracing wires. Two very strong struts are the only projections from the fuselage to hold the wheels. These struts pivot about a pin which is hidden in the fuselage, and the rubber shock-absorber cords are also entirely hidden within the fuselage, as can be seen from the drawing.

The internal bracing and shock-absorption of the landing gear is a great advance in the aerodynamic refinement of the airplane.



An internally braced landing gear with the shock-absorbing mechanism in the fuselage so that resistance is reduced to a minimum



A heavy caterpillar tractor attached to the bow of an airship on the ground

A Tractor for Airships

THE handling of a large airship on the ground is always a difficult problem, which even the mooring mast does not solve entirely A recent patent of the German Zeppelin Company suggests aid.

The airship is anchored at a point near its bow, by the intermediary of springs or other shock-absorbing devices, to a very heavy caterpillar tractor.

Flying Upside Down

THERE is no theoretical reason why an airplane should not fly upside down indefinitely. There must be sufficient power to counteract the inefficiency of the wing in such flying, the aviator must be physically capable of withstanding a flow of blood to the head, and the engine must somehow be supplied with fuel even though the carburetor is high above the main gas tanks. By the simple expedient of placing a tank of gasoline well below the fuselage on an Avro training plane, G. F. van Damme, of the Belgian Army, has flown upside down for the record time of two minutes and 27 seconds.

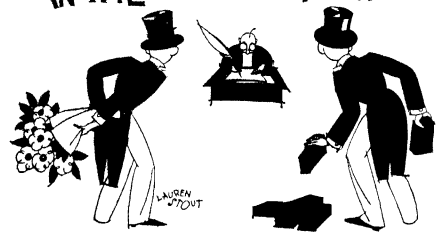
A Huge Mooring Mast

A HUGE mooring mast has been erected at Cardington, England, which is to be the English terminus for the projected British Empire airship service, in which airships of 5,000,000 cubic feet are to be employed. This mast is no longer the slender structure that was once customary, but a broad and solidly braced tower, 200 feet high. It is to be provided with passenger elevators, so that passengers will experience no discomfort in finding their berths aloft.

Kadel & Herbert

A huge mooring mast erected at Cardington, England, to serve as the English terminus of the projected British Empire airship service

IN THE EDITOR'S MAIL



An Alaskan "Dry Land" Gold Dredge

Often people's love of creating some kind of mechanical contrivance that they can call all their own leads them astray as to its economic practicability A reader in Seattle, who recently returned from a prospecting trip in Northern Alaska, sends us the photograph of a contraption which illustrates this point It is a "dry land" dredge, designed to dredge gold on dry land.

Scientific American,
Gentlemen:

Apparently some old "Sourdough," observing the enormous amount of gravel dug up by large million-dollar gold dredges, conceived the idea of a dredge to operate on dry land Cleary Creek, richest of the Fairbanks gold-mining district, if not of all Alaska, was selected for the "experiment." The tailings piles, from which $26,000,000 had been sluiced, remained upon the surface and were expected to yield as a "pay-streak"

Those who are at all familiar with dirt-excavating machinery will readily note the several buckets to the left, which elevate (or were designed to elevate) the "pay-dirt" to a hopper, the "grizzly" or revolving screen which receives the material and sorts out the gravel, and the conveyor belt which disposes of the coarse stuff which is too large to drop through the screen into the gold-sluice below The boiler to the right furnishes steam to operate an engine which drives the mechanism and pumps water into the screen and gold-sluices.

The contraption, as is true of most of these impracticable freakish devices, was not a success and has been abandoned.

The gold-bearing creek channels among the barren hills surrounding Fairbanks have produced $90,000,000 to date.

M. H. Guise.

To Tell Precise Solar Time

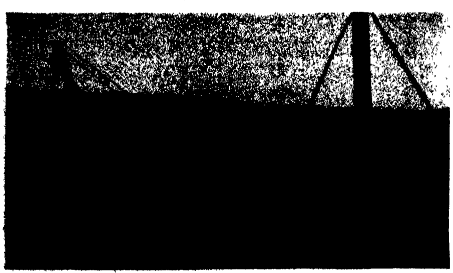
Mr. Hawkesworth, who is the originator of the method of telling solar time described in a letter contributed to our January issue, gives us his final and authoritative determination on this interesting subject

In the Northern Hemisphere Imagine a huge clock face around the Pole Star, with 12 above, and six below—in the usual fashion. Take as our hour hand upon this imaginary clock-face the two stars called the "pointers" of the Great Bear or Dipper. Read the hour indicated thereby, and add to it the number of months, and fraction of a month, elapsed since January 1 Double this sum, and subtract it from 52¼ or 28¼ or 4¼, the test for which of these three Constants we must use being that the remainder must be positive, yet less than 24. The result will be the true solar time—reckoned from midnight—with 12 to 24 for P.M. time.

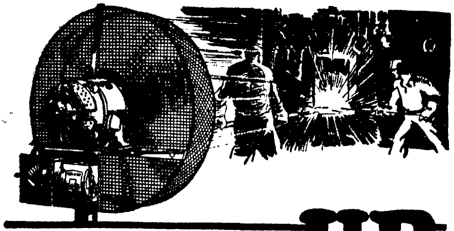
For example: on the evening of September 27, being 8.9 months after January 1, the two pointers are at 7 upon our imaginary clock face, the Dipper being below, and to the left of the Pole Star. Doubling 7 + 8.9 gives 31.8 Subtracting from 52.25 gives 20.45. So that our solar time is 20 hours 27 minutes, or 8 hours 27 minutes P.M.

In the Southern Hemisphere Again imagine a huge clock-face around the South Pole, with 12 above and six below And for our hour hand take the two stars *(alpha and gamma Crucis)* forming the upright of the Southern Cross, since these point almost precisely to the South Pole Read the hour indicated by the slope and direction of the said two stars; and subtract the number of months and fraction of a month, elapsed since January 1 Double this difference, and if the remainder be positive, add it to 6, or if it be negative, subtract it from 30 The result will be the true solar time—reckoned from midnight—with 12 to 24 for P.M. time

For example, on the evening of July 9 the Southern Cross lies on its side to the right of the South Pole, so that its upright indicates 3 upon our imaginary clock-face The elapsed months are 6.3, which subtracted from 3 gives us −3.3—a negative. Doubling this, and subtracting it from 30 gives 23.4. So that our



What is it?



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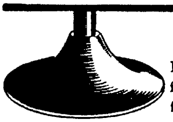

Every time you turn on the desk fan that makes your office a comfortable place in which to work, stop and think.

What are the men doing who are sweltering away on the hot jobs in your plant? What relief have they from stifling heat? Is the heat going to interfere with your production schedules? Will you have to hire more men to meet your shipping dates? Is your labor "turnover season" opening up? How much more efficient and contented would the men in your shop be with relief from the intense heat?

American Blower Man Cooling Fans are like giant desk fans. They provide cool, refreshing breeze on the "hot spots" in your plant. They will make your men contented, enable them to work longer shifts during terrific heat and make it possible for you to meet production schedules that would otherwise be out of the question.

Fortify your shop NOW against delays and losses caused by excessive heat by installing American Blower Man Cooling Fans.

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4 —will cast a cool, refreshing breeze in any desired direction at any time
5 —will enable men to work on hot products with less delay
6 —will enable men to work longer shifts
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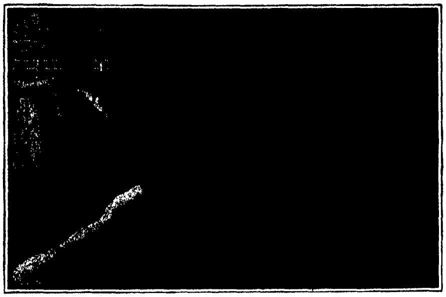

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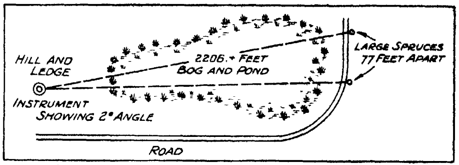


Estimating distance without the usual triangulation methods

solar time is 23 hours 24 minutes, or 11 hours 24 minutes P M

In countries on or near the equator the Poles are on the horizon, so that the Great Bear and the Southern Cross will be below the horizon in the autumn months In which case we can turn to Cassiopeia's Chair and, choosing *Gamma*, the star forming the midmost peak of the "W," imagine a line connecting it with the Pole Star as our hour hand Add the indicated hour to the elapsed months, and fraction of a month Double the sum, and subtract it from 18 13 or 42.13 or 66 13 The result—positive and less than 24—will be the *true* solar time—reckoned from midnight—with 12 to 24 for the P M hours

This use of the Great Bear, or Cassiopeia's Chair, or of the Southern Cross, as a convenient timepiece to check off the long hours of a night watch may commend itself to seamen But a more valuable use would be to determine a ship's or small boat's position during stormy or cloudy weather when a sun observation at *noon* was *unobtainable*, since even a momentary glimpse of these easily recognizable stars would be sufficient at any time during the night. To increase our accuracy in measuring their slopes, or indicated time, we could use, say, a small piece of window glass, diamond scored with the angles in a quadrant, or even marked 30°, 60° and 90°, with soap or tallow Whereupon, of course, the difference between the true *solar time*, so *obtained*, and the known time of any other meridian, given by radio, the ship's chronometer or even a good watch, and that difference multiplied by 15, would at once give us the number of degrees of longitude we were west or east of the said known meridian The result would, no doubt, be merely approximate, but it would be vastly better than a wildly guessed-at dead reckoning It would be priceless to shipwrecked *mariners*, *wind driven* for days in an open boat

Alan S Hawkesworth F R S. A

Must We Cease Using Them for Bait?

We do not remember ever having read an ode to the lowly worm, but since receiving a photograph from Paul E Denton, showing the artistic tendencies of the species, we think the poets ought to get busy.

Editor, Scientific American,
Dear Sir·

Do worms have a sense of the artistic?

It would seem that they do, judging by a wonderful design made by them on the under side of a piece of bark picked up by Harry Stanton at his home in Chardon, Ohio

Stanton was putting some wood in the fire when a large piece of bark fell from a slab He noticed a beautiful design on the bark

It was as if some artist had carefully planned and executed it. The appearance of the design looks as though it had been burned into the wood by some expert pyrographer

"I have been a farmer for many years and this is the first time I ever saw such a remarkable thing," said Stanton "The piece of wood is attracting considerable attention There were many worms in the wood at the time I found it You may be sure that I baked the wood to be sure they were all killed"

Paul E. Denton

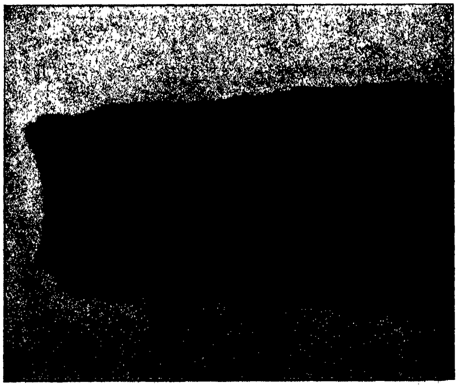
A Surveyors Short-Cut

That Editors are not omniscient is proved by the following:

Editor of the Scientific American.

Dear Sir I wrote in the spring inquiring if there was any "off hand" rule to work triangulation without logarithms, etcetra, and your reply was negative

Now, if one loses his logarithm tables, he can depend on getting out of his dilemma by using two factors that can easily be remembered and which most educated schoolboys have in their heads, namely Remember number of degrees (360) in a circle and the pi (3 1416) relationship of circumference to diameter These require no elaboration to use and should be used by a method known as the "Noyes Rule", (for simple field use it works to a minute accuracy for anything within five degrees), thus with the vertex of the angle given and the length of chord, find distance of radii, i e distance of apex from the ends of the base Rule: divide the degrees



The design on this piece of bark was made by worms

in the circle (360) by the angle; multiply the quotient by the chord (which is the circumference of circle), get the diameter by dividing the circumference figures by 3.1416 and then [illegible] (divide by 2) this for the radius, or distance from the angle to the chord. This method was thought out by the [illegible] diagramed on this page.

This principle can also be applied to find either of the other two distances

Anyone who loses this rule can easily grasp the idea and work it out since its philosophy, when once understood, is simple. Field surveyors, and especially ordinary compass surveyors, find this rule very valuable as well as a great saver of time and expense where valleys, swamps, ponds, et cetera, are in the course of suvrey when no logarithms are at hand.

Dr. B L Noyes,
Stonington, Maine

P.S.—I did surveying when a young man and devised this method years ago

Another Approving Reader

The following letter speaks for itself We are glad to have Mr. Foster's words of commendation.

We were sorry to be obliged to tell Mr Foster that we do not know the whys and wherefores of the naming of Muscle Shoals—except that the shoals in the Tennessee River which mark the site of this much-talked-of development have been known locally for a long time by that name

Editor, Scientific American,
Dear Sir:

In reading my December Scientific American, it surely did me good to see someone give this eternally, execrable and as he puts it, "personally detested" continued-on-page-seventy-eleven, column —— till you tear your hair Give it, I say, a good rap. It is analogous to a person sitting down to a table, ordering a meal, having a part of it served and after eating that serving, being informed that if he is still hungry and if he does not mind the inconvenience, he will find the remainder of his order in room number ——

Like Mr. Lake, I, too, read the advertisements in the Scientific American You would find in my copies many of the lines underscored, for they contain real information, and often beautiful language, making modern advertising almost, if not quite, a science For example, "New York-to-Chicago telephone cables completed, cost $25,000,000, and would take ten lines of poles, each heavily loaded with wires, to carry the circuits contained in this most modern artery of speech" Or, in the advertisement "Cruising to the Caribbean," "Cruising is the only kind of travel that means absolute rest Long luxurious days at sea, among new and strange peoples who are content with little, lands that blaze with exotic color where stately palms mark the line between dazzling white coral and amethyst sea, et cetera." Worth reading? Well, I think so.

Another thing I have been wishing to know, ever since the periodicals began writing about the development of "Muscle Shoals," is why it is called "Muscle Shoals." Isn't the word "mussel," which I believe is a mollusk of the bi-valve variety, more apt to bring to our minds river development? Or are they named from a man by the name of "Muscle?" From some cause, it has always jarred my nerves like a discordant note in music. Imagination? I wonder.

Homer Foster.

Who Else Saw This Meteorite?

In the February issue of the Scientific American, Prof. Henry Norris Russell told how to trace the path of a meteorite. Two observers should see it from rather widely separated points of vantage, after which its actual path can be worked out by geometry. Did anyone else observe the fall of the meteor described in the following letter?

The Scientific American,
Gentlemen:

Herewith I am enclosing details of the transit of a meteorite which I observed at Yucca, Arizona, a way-station on the Santa Fe Railroad, about 18 miles south of Kingman, Arizona.

It appeared just below Arcturus (west) at a point on a direct line between Saturn and the north, one of the pointer stars in Ursa Major. The transit was from this point to the star cloud of the Milky Way in the tail of Scorpio

Time, 2·28 A M, May 1st, Pacific Time· Duration of transit 36 to 40 seconds This computed by repeating a verse which requires 6 seconds to say and was repeating it the seventh time when the meteorite faded from view

Its color was about that of the flame from an ordinary wood fire and it resembled in a small way a skyrocket in that sparks were projected behind from it in its flights Its glow was rather much less than is usual with other meteorites I have observed

Sincerely,
J P Byers,
Winslow, Arizona

Great Whirlwinds

Few of us have ever seen a tornado, often misnamed "cyclone," but far fewer have been in at the actual birth of a group of them. Here is an interesting letter from one of our readers who saw one form and split into several lesser whirls, each of which sped on its devastating way

Scientific American,
Dear Sirs.

Never having read of anyone being actually present at the birth of a tornado, but reading several accounts of how they are formed I, having the privilege of being immediately beneath one, think I should make a record of it for you to pass along to some one to whom it may prove of interest

Owning a farm situated some five miles southwest of Falls City, Nebraska, it is my custom to visit it in May and September each year, upon which occasion it is customary for the man who runs the farm to give a big family dinner on Sunday at which from 35 to 45, big and little, are present

Some 20 or more years ago while we were at table, we heard a moaning sound in the sky which sounded like the moan of a sick dog, and we were all fully impressed with a feeling that something was about to tear loose above

We ran out, and the sky was a sight Clouds were rushing at great speed in different directions We bustled the women and children into a cave and the men ran out into a pasture east of the house

When I got out with the men and looked up, I saw that there were four different directions to the air currents, each one at different altitudes As I looked up, I found I was exactly under a piece of blue sky that formed a perfect square, with perfectly sharp corners

As we watched, it seemed that the different currents of cloud were gradually approaching each other and the corners of the square began to round Suddenly, with a zip, a small tornado broke away and sped just a trifle north of east, taking several panels of my east and west fence as it crossed it. In a short time another small one with the same sound—zip—started, going but a few points farther north than the first, and then with a mighty roar, the big fellow let go and went about northeast This big one was heard of afterwards through newspapers as passing over into Missouri.

We surely felt relieved when we found that none of them had hit the ground closer than a half-mile from us and, as we were congratulating each other and calling the women and children from the cave we were hit by a big hail storm Hail like golf balls peppered us for a short time and then came a big rain.

This is my recollection of this occurrence, and I am sorry someone with more knowledge of "cloudology" was not present to describe it more in detail.

Mr. D. R. Grush and his entire family were witness to this. He resides at Falls City, Nebraska, and can substantiate all I have written in case this experience should need any confirmation.

C. H. Conklin,
Decatur, Illinois.

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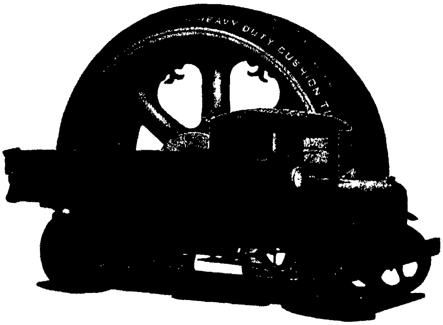

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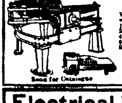

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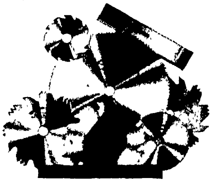

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Science and Money

Preferred Stocks

By Henry C. Trundle

THE preferred stocks of companies with a long established record of dividends on their common stocks may be regarded as reasonably safe and, as they frequently give a higher return on an investment than the bonds of the same companies, can be purchased advisedly if income is preferred to absolute security While bonds fluctuate in price but slightly even though sales or purchases in the market may be large, the same volume of business in the preferred stocks usually will result in a variation in price of several points. Investors who are easily frightened when the quotations of their securities drop precipitately, for their own peace of mind should confine themselves to bonds rather than undertake the risks which attend stocks Otherwise sound preferred stocks are most desirable

The financial structure of a company ordinarily consists of bonds and stocks. Stated in another way, a company obtains its capital from creditors and from partners—the former being the bondholders and the latter the stockholders The difference between owning a half or quarter interest in a concern or owning one hundred shares out of a total of fifty thousand shares in a corporation is just one of degree Of course, in the first instance the relationship may actually be closer, but in the final analysis the relative position is exactly the same

Preferred Stocks Have Prior Claim

As the name suggests, preferred stocks have a prior claim, compared with common stocks, as to dividends and as to assets in the event that a company is dissolved Because of this advantage dividends are limited in amount and the stocks are bereft of any great speculative possibilities It is true that the shares may in time become so highly regarded that they will sell strictly on an investment basis, resulting in an appreciation of several points, but other than this not much action is to be expected marketwise unless one takes the viewpoint that conditions will warrant the stocks selling at a much lower figure

There are different types of preferred stocks just as there are various kinds of bonds. The simplest form is the straight preferred stock which has a first claim to dividends but which can only be paid out of current year profits. In good years and if a company has a sufficient earnings power this arrangement is entirely satisfactory. Some companies run into difficulties every few years and, although a large surplus may have been built up from which dividends could be paid, they cannot be paid because current year earnings do not permit it Obviously it is not fair to preferred stockholders to limit their dividends in good years and to discontinue them in bad years when the surplus would warrant full payments It was to correct this situation that "cumulative" preferred stocks were devised

Cumulative Preferred Stocks

Cumulative preferred stocks are those upon which the dividends accrue and which, if the dividends are at any time earned, must be paid before disbursements can be made upon the common shares Some persons who have striven for a large income and therefore have purchased preferred stocks in preference to bonds have had the unfortunate experience of having to do without any income at all when their companies met with reverses The cumulative feature partly relieves this situation if the company has the ability to ultimately earn amounts sufficient to pay off accumulations and to resume regular payments.

For a period following the war the rubber companies, certain railroads and other companies found it impossible to continue dividends When fortune turned, these companies were several years behind in dividend payments, and although they were able to pay at current rates, they were prohibited from doing so until the arrears were paid. Various arrangements were resorted to—the exchange for additional new stock, the issuance of dividend script notes, full payment in cash or part cash and part stock, either preferred or common. Possibly there has been but a slight loss in income, if any, but certainly it has been most embarrassing to shareholders to be without any income in the very times when such income was especially needed However, back dividends are finally being paid up.

Preferred Stock May Be Exchanged

It may also be the desire to permit the preferred stockholders to share in excessive earnings This is arranged through a clause providing that the preferred stocks shall participate in such earnings to a stated amount after the common shares have received dividends Sometimes these two classes of stock will share the balance to the same amount or the preferred will share only up to say three percent, the balance being applicable to the common. This participation feature is quite common and many stocks are actually paying several dollars extra in this way.

Still another class of preferred is the convertible preferred which may be exchanged for other securities, usually the common stock This stock gives the holder an opportunity to speculate mildly for it later may be advantageous to switch into the common if dividends and the market price warrant it

Employee-Customer Ownership

In recent years public utility companies have obtained large amounts of capital through the sale of preferred stocks, either through customers ownerships campaigns, or through banking concerns. Offerings of industrial shares also have been numerous, while the railroads have done very little of this type of financing. The idea that stock should be sold directly to the people that are served, which has been developed so highly by the public utilities, has revolutionized business and removed much of the cause of socialistic complaint At the present time practically every company of any size attempts to interest its employees in it in a financial way through the ownership of its stock Because of the local nature of the business public utilities are enabled to make almost as strong an appeal to their customers Manufacturing concerns and railroads are also trying to attract customer investment, as well as employee, but the problem is a greater one due to the broader market This employee-customer ownership of companies makes it easier to raise capital and does much to avoid labor and anti-legislative troubles.

An issue of preferred stock may be offered to the public solely on its own merits based upon the earnings record and the popularity of the company. On the other hand it may be necessary to "window dress" the stock through the addition of common stock bonuses or of warrants giving rights of one kind or another. These latter features are common in the case of a new or unknown company or when market conditions make it necessary to add a speculative flavor.

The value of a preferred stock may be ascertained by determining its book value, or the equivalent of assets over liabilities which is behind it. It is not practicable to capitalize the earnings per share, as the dividends are limited to a fixed amount. A comparison of earnings records, surplus

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accounts, operating ratios, and similar financial data of companies engaged in the same general type of business will also give a fairly definite idea of the worth of a stock under consideration, keeping in mind of course the dividend rate and the market price.

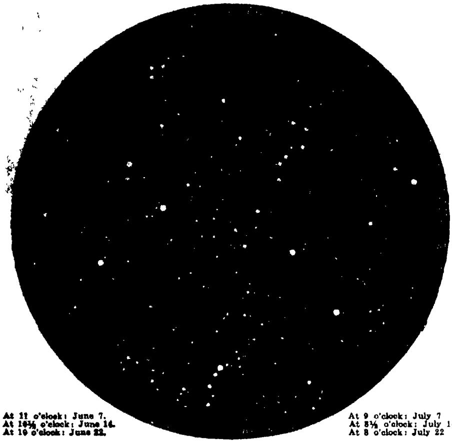
Because of the stabilized nature of the business and the long record of dividends paid on both the preferred and the common, it would appear that the preferred stocks of public utility companies offer unusually good investment values. Although dividends have been paid regularly for years at the rate of $7.00 or seven percent per share many utility preferred stocks are selling at between 90 and 100, giving a return of around seven and eight percent—a most attractive yield considering that the bonds of these same companies yield less than six percent.

Until now no great market sentiment has been built up for utility preferred shares which probably accounts for their selling at prices so much at variance with their value. The preferred stocks of most railroads and some industrials sell on an investment basis, that is, at a price to yield five or six percent. The business of manufacture and distribution is so hazardous, however, that the preferred stocks of such companies are usually regarded as suitable for purchase only by persons in close touch with economic conditions.

Since preferred stocks have neither the security of bonds nor the speculative possibilities of common stocks, they are to be purchased principally when only income and relative security is desired. The inclusion of a few sound preferred stocks in a well balanced investment account will generally increase the average rate of return.

The Heavens in June

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7
At 8½ o'clock: July 14
At 8 o'clock: July 22

At 9½ o'clock: June 30.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY

The Heavens

THE finest part of the sky is now in the east, where Cygnus, Lyra and Aquila are to be found, and the southeast and south, marked by the great star-clouds of Sagittarius and the brilliant constellation, Scorpio.

Hercules and Ophiuchus, almost over head, are less conspicuous; but Boötes, Virgo and Leo brighten up the western sky. Ursa Major is high in the northwest, and Draco and Ursa Minor in the north, while Cepheus and Cassiopeia are in the northeast and lower down.

The Planets

Mercury is in conjunction with the sun on the 4th, and is visible only near the end of the month, when he sets at 9 P.M. Venus is a morning star, rising before 3 A.M. and very conspicuous. Mars is still a morning star, though he rises but a few minutes after midnight by the end of the month. He is in Pisces, not far from the vernal equinox, and is a conspicuous object, as bright as Procyon or Rigel.

Jupiter is past quadrature and comes to the meridian at 4 A.M. on the 22d; but, being 13 degrees south of the equator, he does not rise until a little before 11 P.M.

Saturn being just past opposition, is the most conspicuous of the planets, and is in sight almost all night.

Uranus is in quadrature on the 21st and may be observed in the morning. Neptune sets at about 9:30 P.M in the middle of the month, and is scarcely observable, since so faint an object should be high for good telescopic study.

The moon is in the last quarter at 3 A.M on the 3d, new at 5 A.M. on the 10th, in her first quarter at 6 A.M. on the 18th, and full at 4 P.M. on the 20th. She is nearest the earth on the 1st, farthest off on the 16th, and in perigee again on the 28th. During this month she is in conjunction with Jupiter on the 2d, Mars on the 3d, Uranus on the 4th, Venus on the 6th, Mercury on the 10th, Neptune on the 15th, Saturn on the 22d, and Jupiter again on the 29th.

At 11:30 P.M. on the 21st, the sun reaches the farthest north, and "summer begins."

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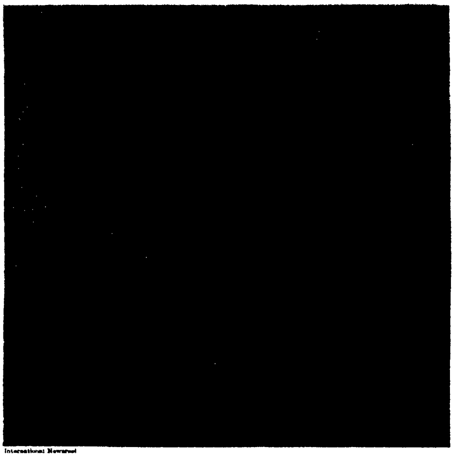
Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



International Newsreel

E. A. Brown, of station 2CV, Richmond Hill, N. Y., has made arrangements to communicate on regular schedules with the operators of the Byrd polar flight. Short wavelengths will be used

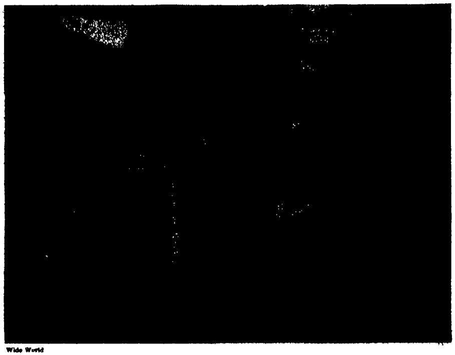
How to Select a Good Battery

THE National Better Business Bureau calls attention of radio fans to the fact that the capacity of a storage "A" battery cannot be judged by the size of the case, weight of the battery or by the specific gravity

How can the consumer play safe in buying a storage battery? The Business Bureau answers this question, "By buying the products of trustworthy manufacturers from trustworthy dealers."

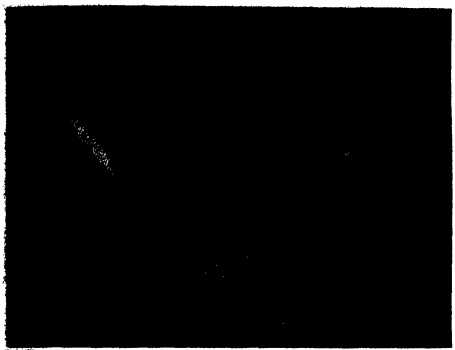
After a survey of the markings on storage batteries sold in New York, the Bureau issued the following report: "The makers of 85 percent of the storage batteries have pledged themselves to follow a code which protects battery buyers. Leading retailers have adopted a corresponding policy in advertising and selling. With such concerns, battery buyers can deal with confidence

"A few manufacturers and some radio dealers have failed to display a similar interest in the protection of the public The popular tendency to regard a storage battery somewhat as a box of mystery has encouraged the marketing of batteries unmarked as to capacity, and so designed that the buyer may overestimate their capacity. Some manufacturers have marketed batteries in oversize boxes or jars. Also, in certain



Wide World

Marconi, the inventor of wireless, standing before the transmitting equipment of an Italian broadcasting station. Note the horn of the microphone, which is not used by American or British stations



Kadel & Herbert

This short-wave receiver has been taken by F. Gow Smith, of the Museum of the American Indian, into the wilds of Brazil where he will study the South American Indians. He expects to hear the short-wave signals of KDKA, WGY and amateurs in the United States. J. B. Brennan, set builder, is on the left and Mr. Smith is on the right

instances, radio dealers have employed inaccurate advertising and selling representations to enhance affirmatively the impression created by the oversize boxes"

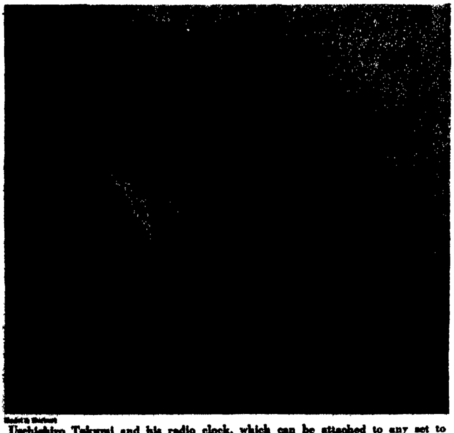
It is pointed out that the essential requirement of a storage battery for radio use is that it shall deliver sufficient power over a reasonable period of time. The capacity of storage batteries is rated in ampere-hours. The ampere-hour is that quantity of electricity which flows in one hour through a circuit carrying a steady current of one ampere. It is the ampere-hour capacity, not size, nor weight nor number of plates, which determines a storage battery's value to a radio set owner

The capacity of the battery depends upon the amount of active material which the battery contains. The integrity and skill of the manufacturer determine how efficiently the lead plates and the acid solution which constitute the active battery elements are proportioned to each other The size of the container is a poor indicator of capacity. A large box may contain less active material, and therefore have less capacity than a small box equipped by another manufacturer Weight is an uncertain indication. A large jar full of acid and containing seven plates per cell may weigh more than a nine-plate battery built in a smaller box, but containing a larger quantity of active materials and thus having the greater capacity

Nor is the number of plates a good criterion of a battery's capacity, because the plates of two batteries may differ in dimensions For example, various types of storage batteries, each having a capacity of 100 ampere hours, have been designed for radio purposes One has nine plates, another eleven, another thirteen, respectively Each has a true capacity of 100 ampere-hours. Each is a good battery

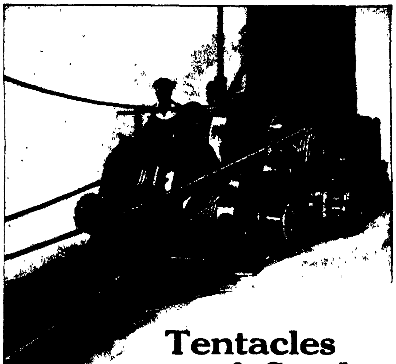
Medal for Saving Life by Radio

Popular Radio has established a Medal to be awarded for conspicuous service to non-



Kadel & Herbert

Uchighiro Tokumi and his radio clock, which can be attached to any set to automatically turn off the receiver and on to pick up any particular features the owner may wish to hear. By turning an indicator to the hour at which the set is to be started, an electric circuit will be closed at that time and the receiver placed in operation



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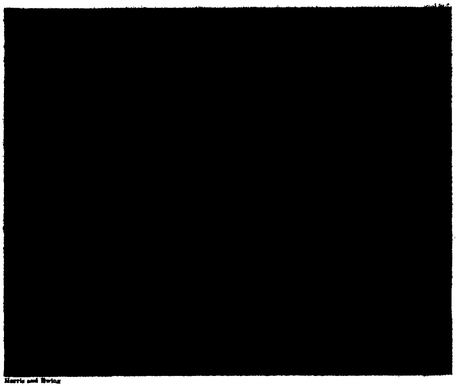


Harris and Ewing

The laboratory of the Bureau of Standards has devised apparatus for determining the distance over which receivers may be expected to give service under all conditions. "Complete service area" means the radius over which reception is possible the year around without trouble from fading or static

professionals who, through prompt and efficient radio action, perform an essential part in the alleviation of human suffering or in the saving of human life. This medal will be awarded to as many individuals as qualify for it and at such times as the Committee of Awards may authorize

Nickel-in-Slot Radio Makes Appearance

A RADIO receiver which operates on the nickel-in-the-slot principle has been developed by Joseph Pinto, of Philadelphia. It is a five-tube circuit, designed for operation with batteries or by direct connection with the house-lighting mains. A red light flashes to indicate the expiration of the time allowance one minute before it is up.

Setting-up Exercises on the Air from WLS

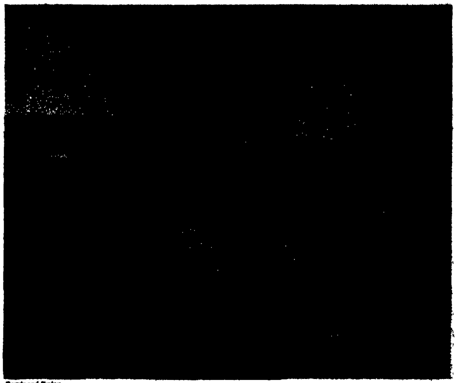
STATION WLS, Chicago, has been added to the list of transmitters broadcasting setting-up exercises. The physical director goes on the air at 6:30 o'clock in the morning under the auspices of the Y. M. C. A. A second exercise period begins at 7:00 o'clock; and at 7:30 o'clock, the Family Worship League holds its meeting over the radio. This service is conducted by the Chicago Church Federation, one minister doing the broadcasting for a week at a time.

Features Embodied in WGBS Equipment

SEVERAL new features in transmitter design are embodied in the installation of WGBS, which has been removed from New York to Astoria, Long Island. The studio is in New York and is connected by land wires with the broadcasting apparatus.

The operator can now control the entire transmitting system by four lever switches, thus eliminating seventeen relays from the control equipment.

A new pilot system has also been installed; if any fuse or circuit breaker opens, pilot lamps and bells operate to reveal the exact location of the trouble. The station is equipped with an automatic tape-recording device which gives the operator a permanent



Harris and Ewing

This apparatus in the laboratory of the Bureau of Standards measures the intensity of the broadcasting stations. Many of the stations are expected to increase their outputs during the summer months to combat static and the long hours of daylight

record of all SOS signals and ship calls on the 600-meter wavelength. Another device automatically takes the transmitter off the air should it vary from its assigned wavelength.

Ground connections are made to 2,000 square feet of copper plate beneath the East River. The aerial is strung between two wooden masts 200 feet above the river. The aerial wires can be lowered to the roof by a dual-motor system. There is a motor at each mast and by pushing a button these motors lower the aerial at both ends, so that it can be repaired or ice-cleared from the wires without delay. A high powered windmill is part of the equipment and is used to charge the batteries. If there is little wind, the batteries are automatically relayed to a charging transformer.

The site of the station is a small peninsula opposite 90th Street, Manhattan

WGY'S Net Extends Across the State

STATION WGY has extended its wire net work across New York State so that programs can be picked up from Buffalo, Rochester, Syracuse, Schenectady, Albany, Poughkeepsie and New York Station WMAK, Lockport, represents the western terminus and through its Buffalo studio, programs are forwarded from that city to the Schenectady transmitter WHAM represents Rochester in the circuit, WFBL, Syracuse and WJZ, New York Entertainment originating in any of these cities may be broadcast simultaneously by all stations in the chain. Canton, New York, is linked to the circuit by radio relay on 1,560 meters through station WCAD

Lodge Says He Can Stop Radio Howls

SIR Oliver Lodge has announced that he has solved the problem of preventing radiating receivers from stirring up the ether with howls which interfere with neighbors It is understood that his method dispenses with antenna tuning and thereby stops radiation Reports from England say that the new discovery will not add to production costs and that the millions of receivers now in use can be altered so as not to act as miniature transmitters.

Exports Increase

EXPORTS of radio equipment from the United States during 1925 exceeded all previous years, according to preliminary figures The figure for last year is placed at $9,903,787, for 1924, $6,030,914; for 1923, $3,448,112 and for 1922, $2,897,779.

In 1919, before broadcasting began, the entire exportation of telegraph instruments, including wireless, amounted to only $830,887

Uncle Sam's best radio customers in 1925 were: Canada, $3,682,483; Japan, $2,216,535; Australia, $675,483, the United Kingdom, $644,916 and Argentina $408,593

Radio broadcasting made considerable progress in Japan last year, as indicated by the fact that Japan reached the $2,000,000 class. That country imported only $35,822 worth of radio instruments in 1924.

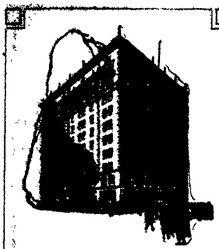
Farmers Like Radio

RADIO receivers on farms in the United States now total approximately 1,000,000, according to the latest estimate of the Department of Agriculture. There were about 145,000 sets on farms in 1923, according to the Department's figures, 365,000 in 1924, and 553,000 in 1925

Neutrodyne Report

THE annual report of the Hazeltine Corporation shows that during 1925 its licensees under the neutrodyne circuit patents did a total business of $11,895,339 This figure represents the net amount received from the distributing section of the trade, and not the actual amount paid by the public.

The operations of the company, according to its profit and loss statement for 1925,



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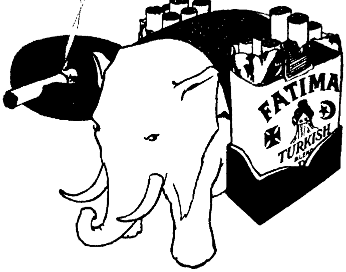

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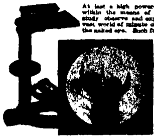

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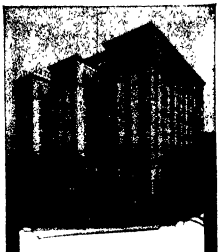

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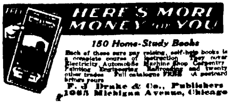

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How We Climbed Our Family Tree

In the June FORUM, HENRY FAIRFIELD OSBORN, President of the American Museum of Natural History, discusses the geological antiquity of man. Professor Osborn maintains that man in human form has been on the earth for 500,000 years and that he belongs to a family of his own which has been independent of all other families for at least 2,500,000 years.

At least one important article of scientific interest by a well-known scientist appears in every issue of THE FORUM. Recent contributors include, J. B. S. Haldane, Julian Huxley, William McDougall, Herbert Joseph Spinden, Vilhjalmur Stefansson, William Beebe, Fridtjof Nansen and Havelock Ellis.

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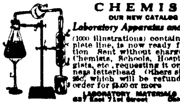

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shows that the profit for the year, after provision for Federal income tax, but before providing for amortization of patents, was $436,058.

A total of 261,416 neutrodyne receivers were sold during 1925 by the fourteen licensees of the Hazeltine patents. This figure is exclusive of kits containing parts for assembling the circuits at home.

Advice to Youth

IT is the opinion of W. H. Priess, President of the Priess Radio Corporation, that the young engineer graduating from college, if interested in radio, should associate himself with a small, compact organization in preference to a large, highly organized concern.

He said, "A small organization is preferable to a large one, because it offers an opportunity for a broader training. In the big organization the assignment would be to a detail of a circuit, such as the proportioning of a transformer or condenser, whereas in the small laboratory, experience would be derived on the entire circuit and its interaction.

"In a big organization the opportunity is seldom offered to study a completely rounded problem. All is specialization in the large laboratory. Nor does the big concern offer the individual the benefit of variety in problems, whereas in the small organization, the variety may be as wide as the field itself, offering its workers circuit problems, any and all.

"Furthermore, the small organization is more likely to develop quickly the 'commercial sense' in its engineers. This is highly important for individual advancement. I use the term in distinguishing between that type of man who enjoys a problem purely for its own sake and the type of man who works on a problem with the thought of its commercial application definitely in mind. The latter is more likely to be developed in a small organization and, naturally, will earn a larger income. The man in the small but efficient laboratory is more likely to develop initiative.

"In two years, on the average, the college recruit should be a fairly good man," said Mr. Priess. "If he has been with one of the smaller organizations he should be a better man than his colleague who went into the large concern."

It is pointed out that much depends upon the man himself. Some engineers can progress more rapidly as a "lone wolf," but others are better adapted for work with a group.

10-Meter Waves Not Suited for Communication

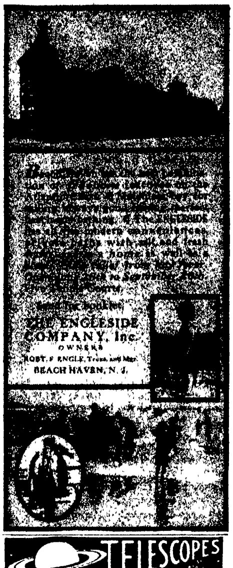
WAVELENGTHS below 10 meters pass off into the infinite and therefore are not suited for communication on the earth, according to Dr. O. E. Hulbert, of the U. S. Naval Research Laboratory, who described the vagaries of the ether to the Franklin Institute. He also said that waves in the neighborhood of 200 meters are not efficient as carriers of broadcast entertainment.

Additional Beacons To Be Established

RADIO beacons have been ordered for the Hawaiian Islands and Alaska, and it is planned that a low-power beacon will be installed on Long Island Sound. Additional beacons will soon be established at Portland, Maine, Los Angeles, Grays Harbor, Washington, and on Lake Michigan. There are now twenty-four beacons in operation along the shores of the United States.

Theatre Program from Seven Stations

STATION KSD, St. Louis, has been linked into WEAF's chain to broadcast the musical program from the Capitol Theatre on Sunday nights from 7:20 to 9:15 P.M., Eastern Standard Time. The network now includes: WEAF, WCAP, WJAR, WWJ, WCAE, WEEI and WTAG.



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**SIR
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English physicist was born at Penkhull, Staffordshire, on the 12th of June, 1851, and was educated at Newport (Salop) grammar school He was intended for a business career, but being attracted to science he entered University College, London, in 1872 graduating D Sc at London University in 1877 In 1875 he was appointed reader in natural philosophy at Bedford College for Women, and in 1879 he became assistant Professor of applied mathematics at University College, London Two years later he was called to the chair of physics in University College, Liverpool, where he remained till in 1900 he was chosen first principal of the new Birmingham University He was knighted in 1902 His original work includes investigations on lighting, the seat of electromotive force in the voltaic cell the phenomena of electrolysis and the speed of the ion electromagnetic waves and wireless telegraphy the motion of the aether near the earth, and the application of electricity to the dispersal of fog and smoke He presided over the mathematical and physical section of the British Association in 1891 and served as President of the Physical Society in 1899 1900 and of the Society for Psychical Research in 1901 1904 President of the British Association 1913 1914, Albert Medallist of the Royal Society of Arts as the pioneer in wireless telegraphy 1919 His recent works on the Atom and Ether are well known

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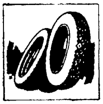
Don'ts for Inventors



When an invention is made it is the latest word in its particular field, but it is by no means the last word Inventions, especially in new fields, are usually far from being perfect and they lend themselves readily to improvements Often an apparatus or a process can be made far more valuable by means of an additional invention which makes for cheaper operation, increased production or superior quality of the output. Such a patented *improvement might be sold profitably either* to a rival concern or to the manufacturer controlling the invention upon which you improve *Don't overlook the inventive possibilities in improvements.*

Remington Wins Patent Suit

THE Court of Appeals of New York has recently handed down a decision in one of the most interesting cases involving patents to be brought into the courts in recent years The decision, upholding the right of the Remington Arms Company to cash register patents claimed by the National Cash Register Company, gives assurance of continued employment to approximately 3,000 workmen of the Remington plant at Ilion, New York.

The entire case revolved about Frederick F. Fuller, known as the oldest cash register inventor in the United States. Fuller had been employed by the National Cash Register Company at $5,000 a year under a contract for one year beginning in 1909 He agreed to transfer to the company all cash register mechanisms made by him during his employment, and if at the end of the contract he left the National's employ, not to enter the service of any other cash register company for a year following the severance of the connection. Any inventions he might make within that one-year period he was to assign to the National Cash Register Company. Shortly after the contract expired Fuller asked for a new term contract. It was refused

Probably no business in America is more dependent for its growth and its continued life upon patents than the cash register business. The Remington Arms Company is said to have spent $1,500,000 in developing the Fuller cash register, of which it has manufactured 58,000 It is estimated that an adverse ruling would have meant a loss of $3,000,000

The Right to Your Own Name

THE right of any man to use his own name in the conduct of his business has generally been recognized as a rule without exceptions. That there may be exceptions even to this rule, however, was reiterated recently when the New York Supreme Court decision, prohibiting Paul Westphal from using the name "Westphal" in business, was upheld by the Appellate Division

The suit was brought by Paul Westphal, Inc, against Paul Westphal and others Both parties manufactured a hair tonic similar in color and put up in containers that were much alike The tonic had its origin when Paul Westphal, a German immigrant barber, put it on the market and called it "Westphal's Auxiliator." His executors incorporated the business in 1910, after his death The present Paul Westphal is the grandson of the founder

"After reading the evidence in the case," the court holds, "we are convinced that the defendants have not acted honestly, but have illegally appropriated the name 'Westphal's' and have sought by advertising and by putting out their goods, to destroy the plaintiff, and, through fraud and deceit, to deprive it of a property right which the plaintiff through long years of hair tonic manufacture, and in advertising the same, and in dealing with the trade, had acquired."

Patents Recently Issued

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Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy

Pertaining to Aeronautics

Flying Machine—Of the type adapted to be operated by man power, or may be driven by an engine in the usual manner Patent 1569794 L Weil, 160 Claremont Ave, New York, N. Y

Aeroplane—Provided with a combination of devices for steering and elevating or lowering the plane, or for stopping the plane in a short space Patent 1575286 J. F D Smith, Georgia School of Technology, Atlanta Ga

Structure and Composition of the Fuselages and Parts Depending Thereon for Aeroplanes—Comprising also a particular arrangement of the controlling *members for the rudders and the skid, and* conferring to the single parts a great resistance Patent 1578073 G Caproni, U. Nobile and R Verduzio, c/o L Laboccetta, Via Due Marcelli 31, Rome, Italy

Electrical Devices

Lamp Socket Holder.—Especially designed for the purpose of attaching and supporting electric lamps on Christmas trees. Patent 1574695 W A Riley, 2 Manhattan Ave., New York, N Y

Multiple Jack and Switch—In which the filament switches and plate circuit switches are operated simultaneously by movement of the plug Patent 1574158 L A Krejci, 1523 W 18th St., Chicago, Ill.

Signal Cane—Wherein means are provided for presenting an electric lamp adjacent the lower end, and a switch mechanism at the grip end Patent 1574623 L Grau, 8833 Bay Parkway, Bensonhurst, N Y.

Electrical Hand Polishing Machine.—An electrically driven machine convenient in form to permit of its being used manually. Patent 1575062 E F. Kaiser, 355 W. 58th St, New York, N Y

Ship Telegraph—Wherein all of the order bells keep ringing until that particular order is replied to by the receiver in the engine room Patent 1575599 W R Hornberger, 2534 S Shields St, Philadelphia, Pa.

Method of Producing, Photographing and Presenting a Cross word Puzzle—In motion picture form upon the screen, the picture being a running account of the puzzle Patent 1575181 I Schwartz, 111 W. Chester Sq, New York, N Y

Drawing Instrument — For making dots, adaptable for use by draftsmen, engineers, artists and others Patent 1575209 A T Jespersen, 5116 Walnut St., Omaha, Neb

Hair Waver—That will produce a "Marcel" wave in a manner to give reasonable permanency to the wave Patent 1575,-578 E Hagemeister, 126 W 66th St., New York, N Y

Bottle Stopper—Which without the use of any tools can be quickly applied to or removed from a bottle Patent 1575556 O. Eick, South Side Bank Bldg, St Louis, Mo.

Shoe Last—Which gives to the shoe sole formed thereon a contour which conforms to the contour of the normal foot Patent 1575527 G H Boehmer, Room 215, Hotel Times Square, 43d St, New York, N Y

Condiment Holder—By means of which the condiments may be singly or collectively dispensed and protected against moisture. Patent 1575506 J H Rogers, 1180 Broad St, Newark, N J

Magazine Pencil.—Using interchangeable leads, the leads being advanced to the point by means of a needle. Patent 1575502. J. E Platon, Smalandsgatan 30, Jonkoping, Sweden.

Ironing Board. — Which is extremely light yet strong, and adapted to be effectively held on a supporting stand Patent 1575494. F. A Lavendier, 53 Exchange St., Pawtucket, R I.

Display Container—For packing confectionery, medicines and similar commodities, when open may be positioned to display its contents Patent 1575467 A. M. Van Wagenen, Jr, 364 Washington St., Norwich, Conn

Reenforced Fabric.—For binding blankets and other articles, a reenforced section extending the full length of the fabric. Patent 1575428 S H. Laury, 450 West Hight St., Carlisle, Pa.

Wireless Communication—By means of a transmitting antenna comprising a vacuous enclosure and an insulated plate disposed therein, said plate being adapted to be utilized for radiating high frequency currents. Patent 1575080. W. S. Ferdon, 5425 Pasea, Kansas City, Mo.

Receiving Antenna for Wireless Telegraphy or Telephony.—In the form of a connecting plug whereby an apparatus for receiving wireless communications may be connected to an electric lighting power circuit. Patent 1575824 C H Eiffert, 901 Maiden Lane, Roanoke, Va

Electric Light Fixture—For producing soft subdued and shadowless light and at the same time evenly illuminating an entire room. Patent 1574296. V LeBeau, c/o Chas I Denechand, 406 Hibernia Bank Bldg, New Orleans, La.

Electrical Heater.—Which makes use of the action of eddy currents in a substantially solid core of preferably magnetic material Patent 1577276 W. Whitten, 301 Germania Ave., Schenectady, N. Y.

Insulator and Fastener for Aerials.—Particularly intended for fastening and insulating indoor aerials to walls, and moldings, permitting the aerial to be securely held at intervals Patent 1577230. E A. Hirschy, 264 W 23rd St., New York, N. Y.

Electrode End Cap—In which the open end is formed with an extended flange permitting of easy application and preventing tearing. Patent 1579118 E Kleinman, c/o H. Caminer Bayreuther Strasse 26, Berlin W. 62, Germany.

Attachment for Sadirons.—In the form of a thermally actuated signal, for use with electrically heated irons, to indicate the heat. Patent 1577127. J D Kaltenback and J Stoll, 34 Ellis St., San Francisco, Calif

Electrical Contact for Terminals of Vacuum Tubes—Whereby a simple attachment to the ordinary prongs will insure a substantial and sure contact. Patent 1579,-156 J. H Siemann, 283 11th St., Brooklyn, N. Y.

Of Interest to Farmers

Marker for Corn Planters.—Including devices for marking places in the ground where the seeds have been dropped. Patent 1574161 J H Long, R. No. 1, Ashtabula, Ohio.

Power Cultivator.—In connection with which two operators are employed, one to manipulate the power, the other to adjust the ground engaging implements. Patent 1575946 M. S. Sullivan, 246 Congress St., Charleston, S. C.

Mere Skill Not Inventive Genius

INVENTORS and manufacturers often attempt to secure patent protection on structural novelties and are surprised to learn that their ideas are not patentable. The reason the Patent Office fails to agree with the view of the inventor is made clear in a recent case in which the United States Supreme Court upheld the decision of a lower court that no patent could be issued for a chute for "wet" concrete. The patent was applied for in 1908, when apparently nothing of the kind had been patented. The court, however, held that the combination did not constitute an invention because there were in existence devices for handling other materials, so similar that it took only the application of engineering ingenuity to adapt them to the particular use.

The decision says:

"To say nothing of the universally known methods and appliances for raising and distributing water, there were ready at hand widely used and generally understood appliances for the elevation and distribution of mobile substances, such as grain and coal, which involved, both in principle and in practical detail, all the elements described in the claims."

Silk Patents to Rent

SILK is now being manufactured from wood at the rate of 150,000,000 pounds a year, a greater volume than the silkworm produces Some of the American cotton and woolen mills, users of artificial silk, have been in Germany seeking processes for the manufacture of this product.

Recently, however, sixty or seventy German patents for the manufacture of artificial silk, cotton and wool from trees were found among the patents controlled by the Chemical Foundation, Inc They were scattered here and there through 7,000 other patents and had been ignored They will now be leased to any corporations which are owned by Americans to the extent of 75 percent at least.

To Legalize Fixed Prices

LEADING manufacturers are indorsing the Capper-Kelly bill recently introduced in Congress to legalize fixed price agreements between manufacturers and dealers.

The bill provides that "in contracts relating to the sale or resale of an article of commerce, the genuineness of which is attested by the trademark or special brand of any grower, producer, manufacturer, or other trademark proprietor who is in fair and open competition, actual or potential, with other growers, manufacturers or owners of similar or competing articles, which contracts are made by the owner of such articles, hereinafter referred to as the vendor, with wholesale or retail dealers, hereinafter referred to as vendees, ...it shall be lawful for such vendees to agree to sell such articles at the prices prescribed by such vendor and such agreement shall not be construed as against public policy or in restraint of trade."

One manufacturer sums up the attitude of the proponents of the bill by saying, "The manufacturer of branded goods is entitled to protection against the type of retailer who uses his merchandise as a football."

Mowing Machine.—Having means for turning over the outer edge of a swath to clear the space for the cutting of next swath. Patent 1576878. J. G. Thynne, Panstowe Ranch, Tulameen, B. C., Canada.

Beet Topper.—Adaptable as an auxiliary to a suitable farm implement, for acting as a rotary topper for the special purpose indicated. Patent 1578288. E. J. Hammer, Miller City, Ohio.

Of General Interest

Improved Paste Tube Cap.—Adapted to collapsible paste tubes, easily operated for allowing the discharge or cut-off of the paste and possesses positive non-losable features Patent 1570238. J. R. Gibson, 38 S. Dearborn St., Chicago, Ill.

Pencil.—Of the self-feeding type, with mechanism whereby the lead may be moved in either direction longitudinally. Patent 1571120. W. K Holmes, 135 Kenmore Place, Brooklyn, N Y.

Combined Refrigerator and Display Counter.—For use in retail stores, to function as a medium of display and a storage place for relatively large cuts of meat. Patent 1570811. E. A. Wilkinson, 2649 Van Ness Ave., San Francisco, Calif.

Container.—For general use, provided with body of sheet material and may be collapsed to occupy very small place when not in use. Patent 1571069. H. L Carpenter, c/o Carpenter Container Co., 1 Broadway, New York, N. Y.

Snap Fastener.—Which is flexible in its connection, strong, and liable to the minimum extent to work loose. Patent 1571117. H H. and S. Guttman, c/o Times Clothes Shop, Room 605 Times Bldg., Broadway, New York, N. Y.

Sink.—Constructed to permit tea kettles and similar vessels to be placed directly beneath either faucet, the vessels being filled without being tilted. Patent 1569978. C E. Howard, 6507 Makee Ave., Los Angeles, Calif.

Artificial Bait.—In which the hooks are ordinarily housed, but become exposed upon the bait being taken by a fish. Patent 1571770. G. E. Fonner, Oxford, Wis.

Ice Box.—For cooling the contents of sealed bottles, the bottles being exposed in tubes to water chilled by melting ice Patent 1571342. C. Paige, Nowata, Okla.

Concrete Column.—Wherein the reinforcing is arranged in horizontal position, and the stresses distributed evenly throughout. Patent 1571799. A. H Reeves, 61 Milford Ave., Newark, N J.

Collar Button.—Which when closed will be substantially flat and will firmly grip the material around the buttonhole. Patent 1571780. J. F. Ahrens, c/o King Collar Button Co., 729 Broadway, New York, N. Y.

Nursing Bottle Holder.—Adapted to support the bottle in an inclined position in order that the contents may be readily extracted. Patent 1571826. J. J. Wellenhoffer, 42 Seneca St., Salamanca, N. Y.

Submarine.—Comprising a central resistant body and non-resistant end portions acting as water-ballast tanks, and torpedo tube housings. Patent 1571833. V. De Feo, c/o G. Capuccio, Via Arsenale N. 17, Turin, Italy.

Fabric Furniture Spring.—Consisting of a plurality of intertwisted wire cables, especially designed for beds, couches or the like. Patent 1571858. V. Massacese, c/o Attilio Verna, 476 9th Ave., New York, N. Y.

Adjustable Support.—Particularly applicable to chair backs, but in any other connections where an adjustable support is necessary. Patent 1571500. T. W. Connolly, Los Angeles, Calif.

Auxiliary Eyeglasses or Spectacles.—That may be applied to ordinary glasses, in cases where an oculist may prescribe colored or prescription glasses. Patent 1571848. W. Lobenstein, 255 Martense St., Brooklyn, N. Y.

Collapsible Box.—In which the end, side, top and bottom sections, can be readily separated and packed flat for shipment. Patent 1572788. A. Gordon, 5618 2nd Ave., Brooklyn, N. Y.

Bead Wire.—Allowing the threading of beads without the employment of a separate needle, the needle being an integral part thereof. Patent 1572749. S. Mollengarden, c/o Royal Importing Co., 220 5th Ave., New York, N. Y.

Extension Arm for Pulley Lines.—Which may be mounted on the outside of a window, and readily swung in when the window is open. Patent 1572819. R. H Smith, 916 Prospect Place, Brooklyn, N. Y.

Spectacles.—Having means for retaining the same against accidental displacement from applied position, without discomfort to the wearer. Patent 1572733 P H. McCourt, 20th and Eugenia Sts., St Louis, Mo.

Grease Dispensing Device.—Adapted to be held in close proximity to the top of a stove, and will right itself after being tilted Patent 1572762. A. H. Brunner, Carbondale, Ill.

Brake-Lining Rack.—On which rolls of brake lining or similar material may be displayed and the material removed in desired lengths. Patent 1572340. E. Warren, 201 Kinsey St., Peoria, Ill

Means for Preventing Adherence of Cast Metal to the Mold.—Comprising a substance containing an appreciable quantity of combined nitrogen in the form of a nitride of titanium. Patent 1570802 F. von Bichowsky, Glendale, Calif.

Indexing Device.—Which will visually index the contents of loose leaf binders, and make the contents instantly discernible Patent 1571479 F W Huber, 504 Cole St, San Francisco, Calif

Place Card.—Formed from a matchbook, by adding to the same a support which will serve as a prop to hold the book in inclined position Patent 1573748 S Rosenstein, c/o Owname Renewable Matchbook Co., 475 Broadway, New York, N Y.

Pocket License Container or Holder—Of cylindrical form, capable of attachment to a key ring, or to a watch chain, to be always at hand Patent 1573663. W. Warren, c/o Richard Mfg Co, Newport, R I.

Fountain Pen.—Adapted to enable the user to write in ink of a plurality of colors, readily interchangeable. Patent 15736090. W J Giovannetti, 216 De Graw St., Brooklyn, N. Y.

Coupling.—Especially adapted to be associated with air hose or similar pipe lines utilized for the transmission of fluid under pressure. Patent 1572979 E A Whybrew, 1312 Harber St, Port Huron, Mich

Means for Intensifying Reproduced Tones.—And step by step harmonizing all the different elements that enter into the reproduction and amplification of phonograph records. Patent 1573265 J Mersman, c/o Mersman & Co., Ottawa, Ohio.

Cloth.—Which may be easily produced with ordinary knitting machines, ornamental strips being utilized to produce a facing Patent 1573788. O C. Wiese, c/o Salomon Fromm, 93 Underhill Ave., Brooklyn, N. Y.

Rope-End Stopper.—Which may be readily applied to the sheared end of a rope in order to prevent unravelling Patent 1573,737. W. G. Norman, 405 W. 45th St., New York, N. Y.

Shoehorn.—Capable of folding, which can be suspended from a button, supported on a key ring, and occupies but very small space. Patent 1573729. H. Martin, 1449 E. 4th St., Brooklyn, N. Y.

Collapsible Bag.—Occupying but small space in a trunk, but convenient for short trips when expanded for use Patent 1573,721. C. H. Loeffler, 1206 Hancock St, Brooklyn, N. Y.

Renewable Match Box.—Including an ornamental cover of suitable material, which functions as an enclosure for "book matches" Patent 1573747 S Rosenstein, c/o Owname Renewable Matchbook Co., 475 Broadway, New York, N. Y

Gun Sight.—An adjustable rear sight, through which a point at the front may be viewed and brought into alignment. Patent 1572294. D. W. King, 12 Geary St., San Francisco, Calif.

Song Motion Picture Film.—Whereby those in a theatre are guided in singing successive words, the singing not being dependent on timing the singing with the beat time of the music. Patent 1573696. M. Fleischer, 1600 Broadway, New York, N. Y.

Bather's Article.—Which may be worn on the person of the bather for the preservation of valuables or small pieces of property. Patent 1573289. R. E. Gilliland, 1110 Interstate Commerce Bldg., Washington, D. C.

Cement-Block Mold Box.—Readily adapted for the production of a plurality of different kinds and sizes of blocks Patent 1574612. R A. Eaton, 21 9th Ave, Haddon Heights, N. J.

Means for Automatically Controlling Traffic.—Constructed in such manner that it may be caused to operate at predetermined intervals at street crossings Patent 1574,606 H. Cook, Jr, 22 Hepworth Ave., Garfield, N J

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Weed Puller.—For pulling weeds from grass lawns, easily inserted into the ground for engaging the root of the weed Patent 1573222 M. T. Coelho, Box 89, Redwood City, Calif

Drawcut Scissors.—Having a special joint construction which will impart a relative longitudinal motion to the blades during the cutting action. Patent 1573442 H L Feddersen, Oakland, Calif

Flue Pipe Support and Insulator.—For maintaining a flue pipe in proper spaced relation to the inflammable parts of ceiling or roof Patent 1573053 F H Gilbertson, 3835 Wisconsin St., Los Angeles, Calif

Ripper for Well Casings.—Which may be inserted by ordinary well drilling machinery to cut a joint which is fast, and permit the casing removal. Patent 1574241. J. A Francis, Grass Creek, Wyo

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Hoist Control Unit.—For the purpose of preventing the over-winding and over-speeding of hoist mechanism employed in the skip of a mine shaft Patent 1573256 H H Logan, c/o Duron Metal Co, 2649 N Kildare Ave, Chicago, Ill.

Mixing and Ejecting Mechanism.—For use in conjunction with a horizontally disposed refrigerator cylinder for pitching the contents in opposite directions. Patent 1573,658 E Thompson, P. O A. 34 Esplanade, New Rochelle, N Y

Derrick.—Having increased flexibility and adaptability of adjustment with respect to the relative positions of the sills Patent 1573713 F Hunt, 941 E 156th St., New York, N Y

Knitting Machine.—Having means whereby a single-feed stocking knitting machine may be converted into a two-feed stripping machine Patent 1573018 J P Primm, c/o Rome Hosiery Mills, Rome, Ga

Plunger-Cleaning Device.—Whereby a plunger may be inserted in a dust-proof casing and thoroughly cleaned of its coating material. Patent 1573720. E C. Lampson, Jefferson, Ohio

Interlocking Device for Laundry Machines.—Which render it impossible to operate the machine when a door is open, or open a door when the machine is in operation. Patent 1574702 B F J Schutt, 257 Hendrix St, Brooklyn, N Y

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Automatic Shifter.—Which will shift a valve, permit the valve to remain in one position a predetermined time, and again shift its position. Patent 1574604 W T Chamberlain, 56 W. 91st St, New York, N. Y.

Alarm Clock Mechanism.—In which the gears are so connected to each other as to entirely do away with retaining pawls and ratchets. Patent 1575063. A. F. Kendle, Syracuse, Neb.

Lasting Attachment for Stapling Machines.—So arranged that the upper is worked or drawn over the last immediately prior to the driving of the temporary fastening Patent 1575279 A H Prenzel, Halifax, Pa

Photographic Printing Machine.—By means of which prints may be taken from a negative in large numbers and at a high speed Patent 1574687 A C Pillsbury, Yosemite National Park, Yosemite, Calif

Piano-Locking Device.—A locking mechanism which will secure the sliding drawer arranged below the keyboard of a reproducing grand piano Patent 1575532 I E and M K Bretzfelder, and J Shady, c/o Krakauer Bros, Cypress Ave & 136th St, Bronx N Y

Fruit Press Drive.—Wherein a spring is interposed between the pressing disk and the driving mechanism for maintaining the disk under tension Patent 1576231 F. Cozzoli, 401 E 2nd St Plainfield, N J

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Automobile Lock.—Constructed in such manner that the operator will know that the locking has not been completed if the engine is still running Patent 1573459 R R. Stabler, c/o V L Gilpin, Canterbury Hall, Baltimore, Md.

Tire Inflating Device.—Adapted to be operated from the engine of the automobile, especially designed for inflating tires of the balloon type Patent 1573725 J F MacDonald, Hillsboro, New Brunswick, Canada.

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Shock Absorber.—Whereby a piston associated with the spring mechanism is caused to operate against a fluid so as to reduce shock to a minimum Patent 1572484 F T Homar, 721 N 9th St, Tucson, Arizona

Vehicle Fender.—A construction adapted for imparting to a motor vehicle the properties of a combined fender and bumper Patent 1573243 J B Henry, 2125 Parkside Ave, Burlingame, Calif

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Signaling Apparatus.—Arranged at each end of a vehicle, for simultaneously moving to indicate right or left turns Patent 1574731 A McLaren, 366 Herkimer St, Brooklyn, N Y

Automobile Tire.—Which when deflated can be quickly and easily placed on the felloe and when inflated will retain its position Patent 1574611 A F Dembek, 230 Van Sielen Ave, Brooklyn, N Y

Headlight Lens.—Which by reason of its special form of construction will give full road illumination, and will prevent glare Patent 1574607 G E Corcoran, c/o Munn, Anderson & Munn, Woolworth Bldg, Broadway, N Y

Mounting for Window Glass.—Especially adapted for use in connection with doors, windows or other openings of an automobile body Patent 1572427 M Fuller, 16th & Carr Sts, Chattanooga, Tenn.

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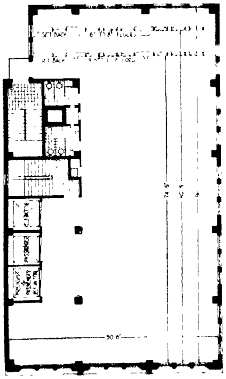

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CANTON, OHIO

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(34)

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